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CONTENTS.

ARTICLES.	PAGE
1. The Interbond of the Seen and the Unseen. Collated by the AUTHOR OF "SCIENTIFIC MATERIALISM"	637
2. Sanitary Agency of Light ..	707
3. Indian Steel. By L. D'A. J..	710
4. Physiology and its Opponents	719
5. From the Debateable Land ..	726
6. On the Irreciprocal Conduction of the Electric Organ of the Torpedo	732
7. Acclimatisation from Another Side..	738
8. The Cause and the Purpose of Luminosity of Marine Animals	740

ANALYSES OF BOOKS.	PAGE
The Wanderings of Plants and Animals from their First Home	743
Transactions and Proceedings of the Royal Society of Victoria..	746
The Ocean: a Treatise on Ocean-Currents and Tides and their Causes, demonstrating the System of the World	748
CORRESPONDENCE.	
Sir Lyon Playfair's Presidential Speech	749
The Differences of Stature and Srength in the Two Sexes ..	749
NOTES..	750

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THE

JOURNAL OF SCIENCE.

DECEMBER, 1885.

I. THE INTERBOND OF THE SEEN AND THE UNSEEN.

Collated by the AUTHOR OF "SCIENTIFIC MATERIALISM."

(Continued from page 643.)

"There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy."—*Hamlet.*

PART II.—NATURE'S DIVINE REVELATIONS.

THIS section of the work begins with the *usual* Fire-mist "In the BEGINNING the Univercœlum was one boundless, undefinable, and unimaginal ocean of LIQUID FIRE.* This was the original condition of matter:

* Is it possible to explain the meaning of "this boundless, undefinable, and unimaginable ocean of liquid fire" as an imagined presentment, being in fact the effulgence of the primal intelligence? This fine mist, matter, or heat, in the subsequent text is explained, inasmuch as it is stated that motion, matter, and heat are synonymous terms. This fire mist is held as a scientific hypothesis, but this does not make it more a fact. Prof. Tyndall says "Not alone the mechanism of the human body but that of the human mind itself—emotion, intellect, will, and all their phenomena—were once latent in a fiery cloud." Porter ("Science and Revelation") truly says "Observation has never yet reached, or can reach, the development of a fiery cloud into emotion, intellect, will, and phenomena of the human mind." With all deference to the originators of the nebulous theory, out of which this fiery development has arisen, I do not believe in its possibility; it is beyond the bounds of all reasoning; there is no proof of it; induction and deduction are equally at fault. What evidence have we? The plutonic rocks! The compression of substances elicits heat, and so the piling of substance on substance is sufficient

"without form, an eternity of motion; without parts, unparticled; an Eternal Sun, without beginning or end, it was a vortex of one Eternity, an infinite circle, the essence of all power; its constitution was not to develop forces, but Omnipotent Power."

"Matter and Power existing as a Whole, inseparable." "The *matter* containing the substance of all Suns, Worlds, and systems of Worlds, with qualities to produce all things existing thereon," producing "Motion, Life, Sensation, and Intelligence, to be impartially disseminated on their surfaces as Ultimates."

"This great centre"—this Great Power of Intelligence, this Great Germ of all existences—was one World, containing the materials and Power to produce all others," with "Wisdom equal to Matter to plan and direct their . . . movements." Its whole "principles were joined into one vast *Vortex* of *Pure Intelligence*."

The whole mass of Matter was as "liquid lava"; the elements then developed were Light and Heat. The Power contained in this great vortex was the GREAT POSITIVE MIND, and its development ETERNAL MOTION: so Matter and Mŏtion constituted the original condition of all

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to account for the modern state of the primitive rocks, without the outrageous idea of liquid fire being the origin and commencement of all things. The heat of the compacting mass, as its materials lay closer and closer, would lose much of its bulk, and consequently of its heat, causing foldings and elevations as layer after layer was thrust out of place, and hence the catastrothisms we read of. What has Chemistry to say to such a state? The whole of space filled with liquid fire, combustion; and of this combustion, what would be the results? The elimination of the elements, or a resulting residuum of uncombined dust? a mass of an unintelligible something. Cosmic dust? of which some of our wonder-working scientists have been so eloquent on. Cosmic dust! or cosmic fiddlesticks; they know as much about the one as the other. An appeal may be made to the flaming hydrogen and nitrogen, the flaming photosphere, and other illogical scientific hypotheses. If, as the spectral analysis proves, all orbs are constituted of the same material, then we must fall back on our Earth—the only orb which we can intimately know. Where is the flaming hydrogen and nitrogen, and fiery photosphere? The brightness of the Sun can be accounted for by magnetic effulgences, a more likely hypothesis; and the elevation and almost immediate collapse of towering flames, volcanic eruptions, and flame floods, glowing lava,—a liquid fire absorbing space,—is a chimera, and worse; it is a chimera enveloped in an absurdity. This fiery furnace is the result of the "scientific imagination" which some of our sensational scientists are so prone to indulge in. "What we groan under is not the tyranny of thought, but the dogmatism of assumptions." "Who are the charlatans? all men who give reproof to the ages by presenting systems in advance of established crudities." Tertullian wisely said "Time is the ally of truth, and wise men believe nothing but what is certain." Goethe tells us "Every bird has its decoy, and every man is misled in a way peculiar to himself."

things. "Cause and Effect were involved in *one* Universal Motion."

Matter, Heat, and Light was the primeval condition of all substance. Its ultimate purification would produce the peculiar essence of animal life and intelligence. From the lowest this was a sphere of progression, "a constant development of inherent principles and laws, the lower containing the higher, and the perfected comprehending all below it. The perpetual vortex was the Spiritual, the perfect and spontaneous substance of the *Great Positive Mind*."

Matter could not "exist without a principle of inherent and Eternal production." "It was impossible for this . . . Positive Power to exist without Matter as its accompaniment and vehicle: that this Matter might assume *forms* the action of the Great Positive Power was necessary to impel it to higher states of progression. Matter thus acted upon was developed until it became an external *Equilibrium* or *Negative*" of the power acting on it. "Thus Positive and Negative" were established, and "Matter was thus obliged to obey every impulse or force given it by the internal principles emanating from the Great Positive Mind."

"The Great First Cause, or Vortex of pure Intelligence, was a *First* or *Cause Internal*.* Matter,† with its properties, &c., may be termed a *Second* or *Effect*; and the external or countervailing force, developed by the action of the internal, was a *Third* or *Ultimate*. In the beginning GOD created—or the *Great Positive Mind* caused"—all "existences and forms."

The lecturer then shows how an incalculable number of Centres or Suns were produced by the condensation of heat and light: from these proceeded planets revolving around their controlling centres, "and so an endless circle of suns and formations were produced corresponding to other circles, each circle bearing an eternal system, and an index or

* In the Vedic poems of Chaos or the Beginning: "Nothing that is was then; even what is not did not exist then. What was it that hid or covered the existing? What was the refuge of what? Was water the deep abyss, the chaos which swallowed up everything? There was no death, nothing immortal. There was no space, no life, and lastly no time. No solar torch by which the Morning might be told from the Evening. That one breathed breathless by itself; other than it, nothing has since been. That one breathed and lived; it enjoyed more than mere existence; yet its life was not dependent upon itself, as our life depends upon the air which we breathe. It breathed, breathless. Darkness there was, and all at first was veiled in gloom profound as ocean."—(*Hist. San. Lit.*, Max Müller.) Talboys Wheeler says, in the "Vedas," as a prevailing idea, "There is the expression of one Supreme Being in all and above all."

† Mr. Fishbough, in a note, says that in speaking of the original condition of things the lecturer used Matter and Fire as synonymous.

symbol of the Great Sun or Focus." Five circles of "Suns and systems of worlds" were produced. The *sixth* circle are Suns only, "pursuing their indefinable orbits in the form and composition of *blazing Comets*. The Great Centre from which these emanated is an exhaustless fountain of never-ending materials; it is a Centre around which all Suns and Suns of Suns revolve." It is a vortex, "an everlasting and unchangeable Parent of all things." It is a Germ which developes its inexpressible attributes throughout the vast Univercœlum and Eternity.

Then follows a repetition of the formation of Suns, &c., until our own Sun is arrived at, and the formation of the planets, which, in accordance with their nearness to the Sun, are more dense. All the systems of Suns are but one system, as all is "but one general Evolution of Worlds from the Great Centre, and therefore but one Infinite production from one Eternal Origin."

"The human mind cannot conceive of Eternity or Infinity, being limited in its nature, belonging to and produced by finite forms, and existing among transient things,"—"but in its sparkling brilliancy the imagination will pass off into infinite space, and, not being able to perceive limits, it becomes confused and bewildered. Although it may contemplate the sidereal heavens, their circumferences, their diameters, and revolutions, and meditate upon their compositions and combinations, and endeavour to conceive the geological formations of each as they were successively developed from the first condensation of particles into worlds, all its conceptions would be *limited*, and could not give *the least possible idea of infinite space*." However, possibly it might be but one system with various formations.

The elements that were successively devolved from the Great Centre which contained them were Heat, Light, and Electricity. Heat was an emanation from fire; and the light produced from heat, by its becoming less particled and more rare, was so sublimated and refined that its ultimate was, and is, that all-pervading element *Electricity*.

There is not so much electricity in the Sun as amounts to a positive attractive power, nor such a thing as positive repulsion produced by principles of like nature. Motion is neither produced nor sustained by any such actuating principles; neither is anything, formed or organised as an effect, produced by positive opposites; for if "a substance could be produced in this way it would be existing in a *vacuum*, and between two antagonistic principles." Hence there would be no motion, action, exchange of particles, neither

increase nor diminution, a destitution of all life or usefulness; instead of opposites, there is harmony in all formations: both are immutable in their adaptations, the one to form and the other to constitute the materials of the formation.

The meaning of attraction, gravitation, and condensation is an *association of particles possessing mutual affinities.* There is a refinement of inherent particles in all bodies, and a constant passing off "of those particles which have become too refined to continue an association in the same composition."

"The constant attraction existing in all bodies in the vast system of planetary worlds is owing to a mutual gravitation from each of particles that have become fitted to associate with the composition of each and of others. And thus Worlds, and Worlds of Worlds, were made, and thus sustained." "And thus the Eternal Laboratory will produce and reproduce until all things and substances shall become rarefied, refined, and perfected, and until they all gravitate to spheres of *celestial* attraction and *spiritual* association."

Electricity (a negative to the internal Positive Power) pervades all space, penetrates all substances, exists throughout all worlds. Every particle in the realms of infinite space contains in its composition unparticled Electricity.

"The great *body* was an *atmosphere* or *halo* surrounding the Great Centre, or Sun, eternally existing; and Heat, Light, and Electricity were successive developments of this great mass." "These are the only principles in existence; all other things are mere *modifications* of these principles;" *everything has its own peculiar atmosphere, and consequently its specific and necessary association.*"

"The *Spiritual Principle*, or destined *Ultimate* of all things in existence, will be a *Negative* to the Great *Positive* Mind, and between the two will emanate *new worlds*, an epoch of another BEGINNING."

"The great fiery ocean of chaotic matter that has breathed into being the *Grand System* of worlds . . . was a universal *Exterior* or *Form*, and a Vehicle of Power, that radiated from *the Internal.* It was a Form produced by the *Invisible* yet *real existing Principle—the Infinite Mind.* Therefore the Great eternal *Interior* and the Great eternal Exterior constituted the only Principle and Form in being."

The causes by which Space was filled with systems of Worlds were established "by the force and spontaneous action of the *Will* of the Eternal mind. The Will (as an effect of the Infinite Mind) as an executive power was the

first Cause of all things." "Every particle in being is constantly passing through *Forms*, *Orders*, and *Degrees*," each "unceasingly seeking association and equilibrium." Every association of atoms, large or small, "has a previous correspondent." Every "correspondent is a type, symbol, and representative of higher and more perfect spheres," but all in an advanced stage of progression. General and special interferences are seemingly existing when things are *particularly* and *minutely* considered; but when the *great System* is considered as a whole, *harmony* alone is visible, and is a *true correspondent of the Vast Universe*, and the whole thus existing receives "the tranquillising influence of DIVINE LAW." *

Solar System.

The Sun, the centre of our system, is but a remote planet of another system existing prior to its formation. The Sun has two motions; one on its axis, the other in its orbit, around a greater centre. Eight planets are determined on; but the *eighth* and *ninth* are not recognised as belonging to the Solar System.† The Sun's atmosphere extended to the orbit occupied by the ninth planet, or rather cometary body. Electricity was the agent by which a transfer was made of molecular substances to new stations.

Then follows a long comment upon the nature of motion and its action upon planetary arrangement, and a description of the *nine* planets, their magnitudes, atmospheres, motions, with the motions of their satellites. He gives the eighth planet, Neptune, six, Uranus six, Saturn seven, Jupiter four moons (no mention is made of those of Mars). He says that the ninth, eighth, and seventh planets are uninhabited. A description is given of the surface appearances, vegetation, animals, and man, in each of the others. The asteroids, which he states are *four* (Ceres, Pallas, Juno, and Vesta), are portions of a planet, "*thrown asunder* by an incomprehensible expansion of interior elements."

The general astronomical dicta are generally in accordance with the attainment of the science of 1846, the eighth and ninth planets excepted.

* Mr. Fishbough, in a note, says the Clairvoyant incidentally said Man was the only being who has pursued a course of isolated and selfish action, governed by laws which never did and never can exist in Nature, or in the plans and institutions of the Great Mind.

† This was March 1846, months before Le Verrier's conclusions had been announced in America (*vide* p. 161).

The Origin and Beginning of the World.

The mythology of primitive nations contains inconceivable conceptions: some that the world assumed its present form and condition in an instant of time; that it was supported in its position by gigantic beings, each supported by others still more powerful, until supposition lost the foundation on which they stood in the realms of fancy and imagination. The opinion reigned, until a few centuries past, that it was perfectly immovable and flattened on its surface. At this time superficial Theology reigned with all power and authority. He who presented a truer conception was nearly sacrificed on the altar of bigotry and superstition. At length the true system of the world, by slow gradations, was exposed. Others supposed that from an incomprehensible *nothing* a tangible *something* was created.

The struggle between Theology and Philosophy continued for a long period. Philosophy struggled to overcome the obstacles thrown in its path; at length it became unchained, and emancipated itself from the thraldom which oppressed it. This World has given birth to all the thoughts conceived by man concerning the constitutions of things: the theatre of human action, of pain, of pleasure, of life and and death, of knowledge and ignorance. The Earth and Nature and her laws have given existence to man, endowed him with faculties and sensibilities, and stamped upon him the impress of Eternal Design, and manifested the laws by which his organism was produced. These are the truths yielded to intelligent seekers.

Man abandoned Nature and reason in search of something unwarrantable, and thus lost sight of the true relations between Nature and Science, and of Science and himself, and so degraded became his condition that thought and feeling (language being inadequate) alone could supply the place of expression. Such was, and to a certain extent still is, the condition of things in a world where Nature put forth its energies to yield happiness to the race of man.

A mass composed of atoms and particles previously constituting the atmosphere of the Sun,—the whole held in appropriate position by mutual relations, the result of the supposed laws of attraction and repulsion,—the whole mass being in a state of igneous fluidity, rotary and orbicular motions were established. The rotary motion by the impetus of particles rushing into it, and the revolutionary motion in an elliptic orbit, having an aphelion and perihelion

in contraposition to the Sun, was an effect produced by the *general* impetus given to it,—by a perpetual application of the forces producing rotary motion. Reasons follow why the mass should be igneous and why fluid, in accord with the general theory.

The surface of the mass was gradually and imperceptibly relieved of its heat, and by shrinking and condensation the surfaces became united by an elastic coating; eventually granite was developed, with surface uneven—made more so by catastrophic and volcanic eruptions owing to the pent-up interior heat. These eruptions caused immense valleys, containing seas of great depth. At this time almost the whole surface of the Earth was covered by water, by the action of which the rocky prominences were worn down. The water of that period was not composed of the same elements as it is now, because it was impossible for oxygen and hydrogen to have been developed in sufficient quantities in combination to produce these oceans.

Oxygen composes a great part of the Earth's crust. Nitrogen greatly pervades Nature. Hydrogen is intermediately active in many substances. Fluorine is an ultimate of nitrogen and hydrogen in combined states. (Carbon in some forms, yet not so extensively as in other elements). There is not existing in Nature any composition which does not contain some or other of these elements, and it is impossible to find them *totally* disconnected.

As to the possibility of dividing Matter into atoms—Matter, including its elements and principles, is joined by association: this shows the impossibility of reducing particles to their ultimate state of disconnection.

"There is a diversity in the attributes and motions of imponderable elements." "For ages these principles have been producing phenomena before the eyes of the world." It is only now (April 29th, 1846) the dia-magnetic principle was discovered,—a great agent in cosmic relations.

The atmosphere which enveloped the pulsing mass in specific gravity was not much less than that of water now existing. No substance yet formed contained elements which did not exist in the primitive formations: the first sedimental stratum followed as a sole consequence of the action of the waters against the ejected rocks, and neither in this nor in the previous formation are any Infusoria or marine polypi, so largely manifested in succeeding formations. Thus granite and the sedimentary rocks may be considered as the primal coating of the igneous mass.

Then follows the formation of different strata, fitting the

whole as a receptacle of life. "First there is an *Embryo* of all other existences,—a *Germ* containing the essential properties to produce higher states of refinement. The very moment that the first particle woke into life, from that moment Life, Sensation, and Intelligence were determined as inevitable and endless results. Life is a progressive development of the principle of *Motion*. Marine plants were the first forms suited for this development." "The whole creation, from the highest to the lowest formations, has proceeded in an order of succession so as to exhibit a general correspondence between Geological and Zoological formations."*

"The substance in granite known as quartz, the most perfect compound of oxygen and silicon combined with limestone in which carbon was extremely condensed, by the union of these and the heat generated thereby, acting with the favourable affinities of the water and the atmosphere, created in some portions of the sea's beds and from partially protruding rocks, a composition assuming apparently the state of rest, while in reality the imperceptible motion existing in it was decomposing and uniting particles, and creating a principle of internal vitality, or *vis vitæ*."

Thus "was breathed into existence the forms termed flowerless and marine plants, the highest type of which is the *fucoides*." Then follows a description of the succession of the forms of life, till the vegetable development of the grauwacke and clay, classed as *avertebrated* because sensation had not yet become a distinct principle." "The

* According to Barry O'Meara a curious illustration of evolution ("Napoleon in Exile," vol. i., p. 198) was delivered by Napoleon:—"There is a link between animals and the Deity. Man is merely a more perfect animal than the rest. He reasons better. But how do we know that animals have not a language of their own? My opinion is that it is presumption in us to say No, because we do not understand them. A horse has memory, knowledge, and love: he knows his master from the servants, though the latter are more constantly with him. I had a horse myself who knew me from any other person, and manifested, by capering and proudly marching with his head erect when I was on his back, his knowledge that he bore a person superior to the others by whom he was surrounded. Neither would he allow any other person to mount him except one groom who constantly took care of him, and when rode by him his motions were far different, and such as seemed to say that he was conscious that he bore an inferior. When I lost my way I was accustomed to throw the reins down his neck, and he always discovered it, in places where I, with all my observation and boasted superior knowledge, could not." (*What a nut for Romanes had he but known this anecdote!* It is a better illustration of the intellect of animals than an educated oyster.) "Who can deny the sagacity of dogs? There is a link between all animals. Plants are so many animals who eat and drink, and there are gradations up to man, who is only the most perfect of them all. The same spirit animates them all in a greater or lesser degree."

term sensation as applied to life, vitality, or a minute degree of motion, is improper. Sensation is as distinct from life as life is from motion. Sensation is the principle which connects the inner life or spirit with the external body."

Tides.

The theory of tides presented by the scientific world is "generally very incorrect." "It has been supposed by a conspicuous astronomer that tides were produced by the law of *attraction*—by the action of the moon upon the earth. This cannot be true; for attraction is not an established principle, especially beyond the atmosphere of any body or substance." "If the moon has any attractive influence upon the earth (more than what consists in the natural relation existing between the two bodies), why, when the moon is in conjunction with the sun, does not the water become *more elevated* on the side of the earth next to these bodies, as might be expected if such attraction existed? Also substances on that side of the earth would not weigh nearly so much as when the moon was otherwise situated. Also when the moon is on the opposite side of the earth, and the earth sustains a position between it and the sun, why is not the elevation of the water *equal* at all portions of the earth? For if the moon and sun exert an equal influence, the results should be an equal height of the water all over the earth."

"The falling to the earth of a substance previously suspended in the air has been termed *gravitation*. The tides have been considered as the result of the same principle. All things have been represented as possessing to a greater or lesser extent the principles of attraction and repulsion—a perfect and established *antagonism*. And, inasmuch as this belief is extensively prevailing, it is not possible that a different theory or hypothesis can be received unless it addresses the understanding of man with more plainness and cogency than the former theory."

"It is a well-ascertained truth in astronomy, and in the principles of mechanics, that a body rotating like the earth on its axis has the greatest tendency to throw off substances in the direction in which it revolves. As the earth revolves from west to east once in twenty-four hours, it must necessarily produce two elevations of water, especially as the water surrounds the whole globe. Every twelve hours the water would be elevated at the extreme east and the extreme west, or, in other words, at given antipodes of the earth. The elevation of the water once in twelve hours is a result

of the centrifugal tendency that the globe creates in one half of its period of rotation, corresponding tides being thus produced on the opposite sides of the earth. There are many things operating incidentally upon the water which produce variations in the periods and elevation of the tides in different places on each portion of the earth. A correct knowledge of the law of fluids will at once demonstrate the cause of the whole phenomenon, and it is by understanding the natural tendency of fluids, and that of all other substances, when subjected to a centrifugal force, that the present explanation of the phenomenon will become established beyond the possibility of refutation.

II. SANITARY AGENCY OF LIGHT.

THE discovery of M. Duclaux described in the last number of this journal for October under the above title would seem to be a necessary corollary of the facts made known by Downes and Blunt in 1877 and 1878, and embodied in two papers read before the Royal Society, and entitled respectively "*On the Effect of Light upon Bacteria and other Organisms*," and "*On the Influence of Light upon Protoplasm*," the conclusion being stated as follows, "Light is inimical to, and, under favourable circumstances, may wholly prevent the development of these organisms, its action upon Bacteria being more energetic than upon the mycelial and torulaceous fungi, which are prone to appear in cultivation fluids. The author went further, and showed that this effect was due to oxidation, which, so far as protoplasm and certain other substances of organic origin were concerned, was stimulated by light, and ended either in the extinction or great depression of the vitality of organisms submitted to it. Moreover they succeeded in localising the action in the spectrum, their conclusions being thus stated.

"It is probable, therefore, that if the phenomena were represented by a curve, the maximum elevation would be found in or near the violet, a rapid descent occurring in the blue or green, after which the line of curve is maintained more or less as far as the visible red;" in other words, the

effect is produced by the more refrangible rays, and may be classed with the chemical phenomena of photography. The sanitary aspect of the subject is only a particular application of a far-reaching law, including probably all animal and vegetable life; and the results of it, so far as botany is concerned, have hardly received the recognition they deserve.

There is a simple experiment in illustration which anyone may make for himself, and which is highly suggestive. Let a bean be put in a little water at the bottom of a tin canister with the cover on (a mustard tin will do well), and kept a day or two in a warm place; on removing the lid, it will be found that the plumule of the seed has shot up into a long, straight, succulent stem. Now make a hole in the tin in such a position that light may fall through it upon the stem about one third of its length from the top. It will be found that the shoot gradually bends over towards the side where the hole is, the curve beginning where the light falls; if a longitudinal section of the stem be made, and examined with a low power under the microscope, the cause of the curvature will be clearly seen. On the concave side the cells are shortened, thickened, and generally huddled together, so that the top has been drawn down towards that side, the effect being evidently due to the check imposed upon the growth of their protoplasmic contents by the action of the light. Whether the thickening of the cell walls implies an increased growth of cellulose (or woody matter) is uncertain, but it is more probable that it is due to the spreading of the same amount of material over a smaller surface. It is to be specially noticed that the bending of the stem, and the thickening of the cells, precedes the appearance of a green colour, which, however, soon follows if the exposure is prolonged.

This little experiment throws a flood of light upon a large class of obscure phenomena connected with the growth and habits of plants; it shows why "etiolated" specimens (*i.e.*, plants grown in the entire or partial absence of light) tend to become spiry, and to throw out lengthened shoots; it will account, too, for many of the observed facts of "heliotrophy"—the turning of plants towards the sun or light—which have previously all been regarded as purely vital phenomena. We seem, also, to get a glimpse at the meaning of the appropriately named "pileus" or cap of a numerous class of fungi represented by the common mushroom, under which the delicate highly-vitalised spores are stowed snugly away out of reach of the light. We find out, too, why the delicate Œthalium, or "flowers of tan"—a

fungus of another class—creeps away during the day and hides itself in the shade, as it is well known to do. In fact, there is a large number of phenomena in the vegetable world, isolated before, which group themselves together under this law, and acquire a significance which they previously wanted.

It is impossible, however, to contemplate this aspect of the action of light in the natural world without having another and a very different one forced upon our attention. If we continue to expose our long white bean shoot to light we find that it becomes *green*. This result, as is well known, is due to the production of chlorophyll, and is the commencement of true growth in the sense of increase, for before the shoot contained nothing but what it obtained from the parent seed and the water in which it was placed, now it is beginning to "shift for itself," and provide its own nutriment from the surrounding air. Now, it seems very strange at first sight that the same white light should promote growth and increase on one hand while it checks and stunts it on the other, but the explanation lies in the nature of white light, which is not one and indivisible, but is made up of rays of many refrangibilities. We have seen that the power of injuring white protoplasm lies chiefly among the more refrangible rays represented by the blue and violet, but it is the yellow and red rays at the other end of the spectrum which produce chlorophyll. And here we come upon another remarkable contrast; the rays at the violet end of the spectrum check vegetable growth by promoting oxidation, those at the red extremity afford nutrition to green plants by promoting de-oxidation, at least in the special case of carbon dioxide, and very probably of water also.

It is not meant to imply that there is a sharp line of demarcation in the spectrum, at either side of which oxidising or de-oxidising influences exist, but that such influences predominate at opposite extremities, the peak or maximum of the curves representing them being thus situated, the declining lines of the curves crossing each other at a neutral zone. Here again we come upon a pregnant fact; the neutral zone of the spectrum, where the curves intersect, and where oxidising and de-oxidising forces both disappear, is situated at or near the *green*.

In the paper alluded to at the commencement of this article, the authors mention "Special colouring matters which filter out the more injurious rays" as one means of protection afforded to protoplasm in the organism, it is

clear that there is here an allusion to chlorophyll, though probably some phenomena in the animal world were also in the writer's mind; the green colour of leaves and plants does undoubtedly protect the delicate protoplasmic cell contents from the injurious action of sunlight, by filtering out the rays of higher refrangibility. The subject is a highly interesting one, and might be pursued much further, but sufficient has been said to show that the influence of light upon protoplasm involves results of the deepest moment in the vegetable, and probably also in the animal world—results which would well repay further investigation, and, even in their practical application, are probably by no means confined to "Sanitary agency."

III. INDIAN STEEL.

By L. D'A. J.

ALMOST every province of India has produced malleable iron from a very early period, even when the rest of the world was going through a bronze age, or perhaps also part of a stone age. The Dehli Láth—a pillar of very pure malleable iron without visible weld, 24 feet long and 16 to 12 inches in diameter—was probably made about A.D. 400, and remains rustless to this day, as a monument of the skill then available.

The iron industry of India is now nearly crushed out, partly by English competition and partly for want of fuel, the vast forests of India having apparently been consumed by the people for domestic purposes, as well as for iron manufacture. All revivals of this industry can only be partial and local.

Steel manufacture of a high class would not, however, meet with the same impediments and difficulties, as tool-steel must always command a relatively high price, and be able to bear a high cost in fuel and in labour. It may be interesting, therefore, to mention the places where *wútz* was formerly manufactured, and the conditions as far as are now known, though many of the details have always remained secret.

The chief object of the human race in all countries, when commencing steel manufacture, was to produce good sword-blades and fish-hooks.

Our forefathers, the Danes, appear to have used swords of two sorts in their earlier period before the conquest of Anglo-Saxon England, and even before their earlier successful buccaneering expeditions into Rhineland, Frankland, and Neustria. The Eddaic poems, both Mythologic and Heroic, refer to the "yellow gleam of the falchion" as well as to the biting iron and the steel blade, valued at a chief's ransom or a chief's daughter's dowry, when the master of fighting men carried spears and shields. Such swords had names, as Brîmir (Grimnismal), and were carefully proved (Hâvamal). They were capable of severing the head from an ox, as effected by the Lord of Goats, Thor, or Jack the Giant-killer, in the Hymiskvidha, and are specially mentioned as made of steel (Hyndluliodh), at a time when the ploughs and sickles were probably of malleable iron, and an iron chest with locks, and even an iron bridge of some sort and unmentioned size, was known to exist.

Before quitting this branch of the subject let us also notice the references in the later Eddaic or Heroic poems.

The sword of Völund, Weland, or Wayland, was a skilfully tempered blade (Völundarkvidha), and not a mere piece of ornamental jewelled smith's work, Völund being a Finnish prince of Ulfdal, Sweden.* A certain sword was specially known by repute (Helgakvidha) among a set of forty-six: it would pierce shields, which at this period were of malleable iron, or partly so. A special spear (probably steel-headed) is borrowed for an occasion. Segurd's sword, named Gram, cuts through Regin's anvil, and cleaves a piece of wool in water; Regin and Fafuir have both named or reputed swords. Guthorm, or Gorram, is cut asunder below the arm-pits by a thrown sword (Gram). After this, however, the keen-edged iron is mentioned (Sigwrtharkvidha Thirdhja); and a sworded and helmed host is distinctively a prince's following,—that is, a group of nobles and gentlemen, jarls and thanes, in distinction to the hûs-carls, churls, and thralls, who carried other weapons, bows and spears generally.

The valuable sword-blades of this period were Walish (Oddrûmargrâtz), either in the sense of Hunnith as then

* We may here notice that Völund was a princely goldsmith and jeweller—not a jewel-monger or tradesman, but a craftsman: much of his gold and jewels probably came by some course from India, and, if so, also his best steel, in the form of the present muffin-shaped ingots, or *kurs*.

understood, or possibly from Gallia,—Wales itself,—or the Pyrennees; but Gunnar, the Gothic chief, boasted (perhaps untruly) of owning swords better than all the Hunnish ones (Atlakvidha).

From these and other collected allusions it appears that during the first five centuries after Christ, or rather after the migration of Odin to Denmark (70 B.C.), the best swords of North European make were Finnish, or made by subject races, the Finns, for their masters the Danes. During the latter five centuries, after the invasion of Attila (433 to 453 A.D.), the best blades were first Hunnish, of perhaps semi-Oriental origin; and at a later period, when Oriental commerce passed through Constantinople and across Europe to Denmark, the sword-blades were truly Oriental, while the ornamentation and hilts were of semi-Roman type, as proved by unearthed specimens from tombs. In the Early crusading period Damascus blades were superior to anything before made.

There is hence proved a successive tendency over centuries to obtain better sword-blades invariably from the East, and culminating in the Damascus blades, so called, of the time of Saltán Sálakuddin.

Since that time the tendency has been steadily downward, arriving at last at the London outfitters' regulation sword, made for trade profit and unfit for use in action.

But reverting to Damascus blades: these nominally came from Persia, but actually from India. We learn from the "Ain-i-Akbar" that Persian traders from Isfahán were, in the time of Abbas, in the habit of going to the Indore, and to the Nirmal Steel-mines in the then province or Subah of Barár, superintending the steel-making operations, weighing the proportions, testing the toughness, and taking the *wútz* steel to Persia, where the ores could not produce the same qualities. It is probable, therefore, that there were also other unmentioned places in India supplying Commerce with steel, not only then, but for many centuries before; or, in other words, India had always supplied Europe with the *best* steel, at least since A.D. 400, when the Dehli Láth indicated a high pitch of excellence in metal working, and probably since the Odinic migration (B.C. 70), or before it.

The term Wútz being now, and perhaps always, distinctive of a special best steel, for which the generic term is *aspat*, or *ispat*, it is necessary to notice that the word itself is Telegu, indicating the ancient Telingana, Eastern Haidarabad, or Subah Warádh or Barár (all of which are identical territories) as the chief seat of manufacture, of

which the neighbourhood of Nirmal is a part. We have also a certain amount of modern and recent information as to wútz manufacture, which is not quite extinct.

Superior steels, including wútz, were formerly made from the ores of Bajaur, near Peshawar, and in Kachh; probably also in Assam, where large cannon were made, and in Gualior, Bijawar, and Indor: these places and provinces comprise the whole of the seats of old steel manufacture in Northern India that are now known.

In Southern India the probable seats were Palaman (Bengal), Jashpur and Gangpur, Madgole, Sambalpur, Narsingpur, Surat, and various places in the Konkan, Haidarabad territory, Satara, Maisur territory, Kadapa, and perhaps several places in the extreme south of the peninsula.

The essential points in wútz-making seem to have been the use of iron of two ores, one magnetic sand, or magnetite obtained by mechanical separation from rock, the other a rich laterite; an enormous amount of fuel, perpetual reconstruction of furnaces, certain charcoals, and leaves and roots of certain plants; possibly also small quantities of some flags and fluxes. Some of the charcoals used were—Bamboo charcoal, sal (*Shorea robusta*), bijasal (*Dipterocarpus marsupium*), mhawa (*Bassia latifolia*), teak, dhao (*Conocarpus latifolia*) and ker (*Acacia catechu*); also green leaves of the *Convolvulus laurifolia* or *Ipomea*, stems of the *Cassia auriculata*, and leaves of the ak or madar (a large Asclepiad, *Calatropis gigantea*), as well as the charcoal of its roots.

In olden times, when fuel was plentiful, the chief requisite was evidently the magnetic iron sand, or magnetite, capable of mechanical reduction; and apparently it was also indispensable, while much of the rest may have admitted of substitutes under some variety of treatment. There are doubtless theories that some special excellence may have been locally due to amount of protoxide of iron, to manganiferous or titaniferous ores, or to slightly calciferous ores; but none of these are fully proved. There may have been some special secrets of treatment or manufacture, but everything points to excessive purity of iron, judicious blending, and selected charcoals, as the chief matters on which general excellence was based.

In India magnetite occurs in beds or veins, in metamorphic or gneissic rock, also in transition rock, and in Dakhan-trap; apparently not in other formations to any large

extent, excepting the black iron sands, or magnetic iron sands, formed by natural disintegration from the older rocks, without any chemical transformation of the iron. The only substitutes for this iron, in pure flakes or grains, seem to be pisolitic and subnummulitic concretions, which are frequently very pure and unaltered.

The other element in steel or wútz manufacture is personal metallurgic skill. In India this appears to have been one of the qualities of the old races, or so-called indigenous races, the Kols, Gonds, Santals, Aguriahs, &c., as distinct from the otherwise superior races, the Low Hindoos, and the Kshatri, Rajput, and Brahman of the Upper Hindoo race. We find the analogy in Europe: the good metal-working races having personal skill were the Finns, the Biscayans, the Silurian, and Cornish; while the Angles, Saxons, and Danes have, in their larger operations, trusted to extensive mechanism and systematic management, reducing the worker to a mere mechanical unit. This is a mode of obtaining large results, under a routine, with a fair average in quality at a small expense, but it is not the way to attain excellence in detail; it is, in fact, the principle of democracy as opposed to aristocracy, when applied to work and progress.

If the steel manufacture is to be re-established in India, in its former splendour, the old principles must form the basis of action, while the scientific powers of the English must aid in direction and forecast.

The enormous mineral wealth of India, chiefly Southern India, in the form of magnetic iron, is a matter about which no doubt exists. Salim and Travankur could alone supply Europe for many centuries. As to the general distribution of iron ores that occur in abundance and workable quality, or have been already worked at various places, the author has compiled the following table from data in Ball's volume on "Economic Geology" (London, 1881), the arrangement being in accordance with the classification adopted elsewhere in his own books. This table supports the statements already made on the subject of steel.

London, October, 1885.

The Iron Ores of India.

North-Western India.

Afghanistan.—Iron ore imported from Peshawar.

Derajab, &c.—

1. Kanigurano: limonite, in shales below nummulitic limestone, black and magnetic.
2. Bannu: earthy hæmatites, in nodular masses.
3. Bajano (near Peshawar): black magnetic iron sand; steel used for gun-barrels.

Sind.—Lainyan (near Kotri): local masses of magnetite; bands of red and brown hæmatite.

Punjab.—

1. Mundi: iron sands.
2. Kohad (Kangra): magnetic and micaceous ores, in metamorphic rock.
3. Kot Kerana (Ihelam): hæmatite.

Rajputana.—

1. Bhangarh and Rajgarh (Alwar): ores consisting of a mixture of limonite, magnetite, and oxide of manganese.
2. Kerwar (Jaipur): large old mines.
3. Gangar (Udepur): ores in a bed of limonite with associated psilomelane.

Guzrat.—

1. Palanpur (Pauch Mahals) and Narukot: old mines.
2. (Ahmadabad) Gogha: old iron-works.
3. Ranawao and Ranpur (Kathiawar): lateritic ores, yielding 40 per cent.

Kachh.—Bachan, Lunva, Dudhai, Madh, and Vibroi: sub-nummulitic lateritic ores, also ferruginous deposits; *wútz* formerly made.

North-Eastern India.

Sirmur.—Chaita (Nahan): magnetite, probably mixed with specular ore.

Gurgana.—Firozpur: brown hæmatites.

Kumaon.—Ramgarh: micaceous hæmatite.

Nipáland Bhutan.—Unknown.

Assam.—

1. Impure limonite from the Sub-Himalayan strata.

2. Nodular clay-ironstones, and thin beds of it, at Tirugaon and Tel Pung-Brahmaputra Valley, in Upper Assam, yielding 22 to 40 per cent of iron. Old manufacture of large cannon in the 16th century: metal 7¾″ thick; gun 17 feet long.
3. Pandua: iron ores, magnetic.
4. Cherrapunji: iron sands, composed of minute crystals of titaniferous magnetic oxide, obtained by surface raking of partly decomposed granite. It is suitable for making *wútz*, knives, and hooks.

Bahar and *Bengal.*

Birbhum.—Partly earthy and partly magnetic oxides of iron disseminated in soapy trappean claystone, at Ballia, Deocha, Dunora, and Goanpur; an ore containing 46 per cent of iron, up to 60.

Monghir.—Bhimband (Karakpur Hills): lateritic ores, and thin bands in schists.

Raniganj.—Ironstone shales between the coal-bearing strata (Raniganj and Barakar groups), yielding 24 to 69 per cent of iron in ore chosen.

Manbhum.—Small quantities of magnetic iron-sand; ironstone shales and ferruginous concretions from shale-beds and sandstones; bedded magnetites on the Kasai.

Hazaribagh.—Ironstone shales.

Rewah.—Ore from Coal-measure rocks in Singrauli, and at Hindawa.

Bundalkhand.—

1. Lower lateritic ore near Simereah.
2. Red hæmatite, subcrystalline from the Bijawar series of rocks.

Gualior.—Manganiferous red iron ore; magnetic ores; manganiferous brown iron ore: siliceous hæmatites: all extensively worked in ancient times.

Banda.—Old mines at Goharbai, Deori, and Khirani.

Lalatpur.—

1. Sulda: pure hæmatite.
2. Pura: ores, steely, and yielding kheri.

Bijáwar.—Ancient large manufacture at Hirapur.

Panna.—Old mines.

Indor and *Malwa.*—Old steel-mines mentioned in the Ain-i-Akbari; present information none.

Southern India.

Bengal, part of.

Lohurdugga.—Laterite and beds in metamorphic rock.

Palamao.—Pure magnetic ore and decomposed altered ore, from metamorphotic rock; bedded shales of siderite (black band); concretionary masses of limonite and brown hæmatite, also red hæmatite, from the Barakar group of Coal-measures; bands of red and brown hæmatite in high level; laterite capping the plateau: yielding 33 to 56 per cent of iron.

Singbhum.—Manganiferous ores in lodes near Chaibassa; lateritic ores; pure hæmatites associated with trap; ferruginous schists.

Orissa.—Talchir ironstone shales; concretionary masses in the Upper Barakas group; nodules of laterite. Large manufacture in olden times.

Chutia Nagpur.—Ores in Jashpur and Gangpur, perhaps lateritic: famed for weapons and tools.

Vizagapatam.—Brown hæmatite, as matrix of a breccia; lateritic ores. Wútz made at Madgole.

Sambalpur.—Bands of decomposed magnetite; ironstones of the Kingir sandstone series. Large manufactures of tools and weapons.

Bilaspur, Raipur, Mandla.—Former large mines and manufacture.

Jabalpur.—Kumbhi black iron sand; hæmatites from Gondwana sandstones; lateritic ores of Bifaragugarh; Jaoli ores from transition (Bijawar) rocks.

Narsinghpur.—Tendukhera ores in irregular pits in transition rocks; masses of specular iron; brown and red hæmatites. Steel made here until 1827.

Sagar, Damoh, and *Koshangabad.*—Very pure red hæmatite in nests, in transition bands of brown hæmatite, in metamorphic rocks.

Nimar.—Barwai ores, breccia in matrix of brown hæmatite; Nandia limonites in globular lumps; Mitanderpur rich hæmatites.

Surat.—Magnetic sand at the mouths of rivers; ores of Balsar, Pardi, and Bodhan. Old manufactories.

Koukan.—Rich laterites; also magnetic and hæmatitic ores associated with metamorphic rock. Old works at Vingorla, Malwan, Kapadvanj, Jambughora, Sunodra, Bhelod, Ratanpur, and Tadkesar.

Godavari Basin.

Bhandara.—Mines in Chandpur, Tirora, Pratabgarh.
Balaghat.—Old mines.
Chanda.—Khandeshwar Hill ores (near Dewalgaon); Lohara Hill Ores, compact crystalline hæmatite, with some magnetic oxide,—69 per cent iron; Pepalgaon ores, similar, and masses of brown hæmatite; Ratnapus brown iron ores, 50 per cent iron, in lodes; also ores at Ogulpet, Metapur, Bhanapur, Menda, Gunjwahi,—mostly hæmatite, but also magnetic ores; besides rich lateritic ores.
Haidarabad.—Dimdurti scaly iron diffused in gneiss; Mirtapalli magnetic iron sand; Kondapur lateritic iron; Hunumkonda magnetite; Warangal titaniferous iron ore, also hæmatites; Kullur and Anantagiri ores.
Godavari.—Golapilli, Tripatti, and Rajamahendri ores from sandstone.

Kistna Basin.

Satara.—Mahabaleshwar nodular hæmatite associated with laterite. Manufacture of wutz.
Kothapur.—Ores in Vishalgarh, Kunala, and Kolhapur,—some are lateritic.
Karmil.—Pure specular ore of the Ganigal range.
Ballari.—Manganiferous and other ores unknown.
Moisur.—Black iron sand of Madhugiri and Chinharaindurga; also ironstone ore,—wutz made largely. Chittaldrug limonites and hæmatites; magnetic sand of Kostagiri; ores of Heggaddevankot and Malvilli; Kodachadri magnetic ores; Kadur ores; Chikayakanhalli ores.

Penner Basin.

Siliceous hæmatites, ferruginous quartzites, and other ores, from the rocks of the Kadapah series: agricultural implements made. Nellur magnetites of Ongole and Gundbakamma in gneissic rocks.

South-Eastern Basins, &c.

Chinglipat.—Iron ores of some sort; also near Madras.
Arkat.—Titaniferous magnetic iron sand of Teragutty, Trinomolai, and Chinna Tripatti iron ores.

Salun.—Enormous development of magnetic ores, in the Godumullay, Tullamullay, Singipullay, Tirthamullay, and Kanjamullay Hills. These ores were used in the Porto Novo foundries.
Koimbatur.—Magnetic sand and other ore.
Nilgiris.—Specular ores, hæmatites, also magnetites, at Kotagisi and Jakatalla.
Bepur.—Lateritic ores.
Malabar.—Black magnetic sand and laterite.
Trichinopolli.—Ferruginous nodules from cretaceous rock.
Madura.—Lateritic conglomerate; some magnetic iron.
Travankur.—Magnetites in syenite and granite; also laterite.

IV. PHYSIOLOGY AND ITS OPPONENTS.*

(Concluded from page 656.)

THE manner in which Bestiarians—many of them are sportsmen—excuse themselves for denouncing physiological research whilst justifying hunting, angling, &c., is farcical in the extreme. Miss Cobbe writes: "But it is almost ludicrous to compare a fox-hunt (for example), with its free chance of escape and its almost instantaneous termination in the annihilation of the poor fox when captured, with the slow long-drawn agonies of an affectionate trustful dog, fastened down limb by limb and mangled on its torture trough." Concerning this outburst, Mr. Robertson justly remarks, "Here we have a sample of the vicious reasoning of anti-vivisectionists, and at the same time an exhibition of positive defect of imagination arising out of the moral bias. Note the fatuity of the phrase about 'free chances of escape,' and the assumption that the fox suffers nothing save in the moment of death. But worst of all is the clear implication that to find enjoyment in the terror of a hunted animal is venial beside the simple act of inflicting pain for an ulterior scientific end. Miss Cobbe,

* Apologia or explanation of my last Article on Vivisection which appeared in a London Journal, September, 1, 1884. By a "WEAK WOMAN" who withholds her name.
The Ethics of Vivisection. By J. ROBERTSON. From "Our Corner." August 1, 1885.

after admitting that field sports do not 'seem to harmonize with the highest type of cultivated and human feeling,' goes on to say that the men who follow them may at least plead the excuses of custom and partial ignorance. This when the very contention in dispute is that the reasoned and deliberate scientific action is right, while the following of custom and primitive instinct is barbarous."

With all this we can agree. But in the sentence quoted from Miss Cobbe falsehoods and fallacies lie strewn so thickly that Mr. Robertson does not note them all. The dog, when such happens to be the subject, is not necessarily "affectionate and trustful." He is not subject to "slow, long-drawn agonies," because he is, unlike the fox, under the influence of anæsthetics. Further, in a large number of cases the operations are instantaneous, and occasion about as much pain as does vaccination.

But Miss Cobbe, besides her exaggerations and distortions of facts, shows, in selecting "for example, a fox hunt," no small degree of petty cunning. Let us, on the contrary, take for example a tame deer which has no more "chased and been chased all its days" than has a calf, but which is, some fine day, brought in a cart to be hunted by the royal buckhounds. What of its terror? Or take the case of a salmon hooked, and "played," as we have read, for *three hours*. This play consists in compelling the fish to swim with open mouth against the stream, unable to breathe freely, until it is, in fact, killed by exhaustion and slow suffocation.

Does not such a salmon sustain—if sensitive, and the Anti-Vivisection Act recognises its sensitiveness—more "slow, long-drawn agonies" than Miss Cobbe's "affectionate, trustful dog?" Or, take the case of a frog, impaled alive on a hook and left all night struggling in the water as a bait for jack? Yet these anglers are absolved both by the Act and by the sentimentalists, whose shrieks have been the main argument in its favour. Or, again, let us consider pigeons or sparrows shot down at meetings of gun-clubs, but not necessarily killed; left to lie in pain until discovered by some prowling weasel, cat, or "affectionate trustful dog." Surely in these instances, and in many more which might be adduced, there is "torture" not instantaneous, but prolonged, not assuaged by anæsthetics, certainly equalling, or rather exceeding in amount, the average of the suffering inflicted in physiological experiments. What right, then, have those who practise such things themselves as a mere pastime, or who defend them when practised by others

to turn round upon the physiologist who inflicts, in a few instances, pain in pursuit of knowledge? Of all the inconsistencies which have stained human nature, this, surely, is the most glaring.

Another argument of the Bestiarians, or what passes for argument with them and their dupes, is to call the physiologist "cold-blooded." He acts, of necessity, calmly and deliberately, and is therefore, forsooth, to be execrated, whilst the sportsman, the aggressive soldier, Muscovite or other, the cock-fighter, bull-baiter, and the like, is to be pardoned because he gets excited!

To this Mr. Robertson replies that, "thoughtlessness in sport, as in everything else, makes against civilization."

But we may go further; the fox-hunter is, doubtless, excited when the hounds are in full cry, and when he plies whip and spur, dashing onwards to be in at the death. But was the same sportsman excited when he carefully selected his hunter, when he bought and donned the orthodox costume, when he subscribed to the hounds, and when he rode to the meet? We trow not; we believe that in all these things he acted as deliberately—as "cold-bloodedly" if you prefer it—as does the experimental physiologist in carrying out his researches.

"In the field of battle, where every man in each contending army fights for home and country under the inspiration of enthusiasm, ambition, or the desire for renown," as that "facile sciolist," Dr. Anna Kingsford, exclaims, the individual soldier may get excited. But where is the excitement in an imperial *chancellerie* when the command, or the tacit permission, is given to attack some unoffending neighbour?

Here, surely, if anywhere, is "cold blood." Yet, if report belie him not, an eminent statesman has recently joined the Bestiarian ranks who, not very many years ago, quietly prepared for a struggle, and then deliberately, and of malice aforethought, tempted an unprepared neighbour to declare war.

"Blood," it seems, may be freely shed provided it is only not that of dogs, and "iron" may be used with the full sanction of Bestiarian oracles, if only it be in the shape of bayonet and sabre, and not of scalpel.

Mr. Robertson asks:—"Ought we to help to maintain close checks on vivisection whilst those who oppose the practice not only clamour for its entire suppression, but openly make light of barbarous practices, as to the immorality and perniciousness of which there can be no

dispute among cool moralists?" He further declares that: "We have the spectacle of the anti-vivisection movement making for irrationality in ethics, empiricism in general thought, gross partiality in practice, falsehood in controversy, and the encouragement of the military spirit."

There is a further sneer against physiological research, common enough, but which does not come under Mr. Robertson's searching analysis. Physiology is dubbed the "coward science." Physiological expediency is "cowardly." Let us for a moment look closely into the pseudo argument. The term coward is rightly and logically applied to the man who shrinks from danger which it is his duty to encounter, and to him only. But an action cannot be rationally called cowardly because it happens to involve no danger. "Vivisection," moreover, is often exceedingly dangerous. Pasteur, a man who never took the life of any creature for amusement, has often been in extreme peril in his researches on rabies. When collecting the virus from the jaws of a mad dog the slipping of a cord, or the slightest inaccuracy of manipulation on his part would, without fail, have involved a fearful death. But the employers of this phrase seek to justify it by the cavil that it is "cowardly" to inflict pain or death upon beings which are unable to resist. It is hard to realise the full absurdity of this plea. The very essence of experiment in any science is that the substances acted upon shall have no power of withdrawing themselves from the intended reaction.

But if physiological experimentation is "cowardly" because the subjects cannot resist, ninety-nine-hundredths, at least, of the cases where man inflicts pain or death upon the lower animals fall in the same category. What resistance can the colt, the calf, or the pig make against the castrator? How is the sheep to defend itself against the butcher, or the chicken, turkey, or duck against the poulterer? Can the pheasant, the partridge, grouse, or snipe withstand the sportsman? Even the ox is so secured in the slaughter-house that escape or resistance is out of the question. Why, then, should the term "coward" be bestowed upon the physiologist rather than upon the butcher, the sportsman, the castrator, or the drover, or all who torture or destroy animals for convenience, for amusement, or for gain? Every conceivable answer which can be given to this question is a demonstrable falsehood, save one. And that one is that the maenads of Victoria Street are very willing to dispense with science—in fact, preferring ignorance—but are not for a moment prepared to dispense with

mutton and veal, duck and turkey, oysters and lobsters, furs and feathers, or with "manly" sports and the compulsory services of beasts of burden. We plead merely for some approach to logical consistency, and we plead in vain. So far as we can see, one man, and one only, if such exist, is intellectually and morally free to take up his parable against "vivisection"—the man who holds it wrong to inflict pain or death upon the lower animals for any purpose, and who lives up to his profession. Such a person might legitimately institute a "zoophilist" crusade, and might, undoubtedly, if he thought proper, begin by attacking experimental physiology. In so doing he, at least, would not be open *ab initio* to the charges of inconsistency and hypocrisy. Whether he would avoid the mendacity which clings like Gehazi's leprosy to agitators is another question.

But we must now turn from Mr. Robertson and his most able exposure of the sophisms of Miss Cobbe to the production which we have bracketed along with his memoir. The anonymous authoress is so wild in her statements and her ideas that Miss Cobbe, Mrs. Kingsford, and her other colleagues seem, in comparison, calm, consistent, and rational. Her circular, or whatever it may be called, is said to be a reprint from a "London journal." Whether it be from the "Zoophilist," the "Police News," or the "Spectator" we do not care to inquire. But we must say that it consists of misstatements in fact blended with almost every possible variety of fallacy,—such an Augean stable of misconception and misrepresentation that no man knows where to begin its exposure. It is sad, pitiful in the extreme, that in a so-called civilized country even one person can be found to write as this anonymous lady has written—sadder and more pitiable still that in some quarters she evidently meets with sympathy. She begins by proposing that condemned criminals, instead of rabbits, guinea-pigs, dogs, &c., shall be made the subjects of physiological experiments. She asks why a doctor may not go to a condemned cell and say: "There is an operation to be performed in the hospital the day after to-morrow. It is useless to use animals for it *because their bodies are not in the least like ours* (*sic!*), and the results are not much, if any. If you like to accept the risk you may. It will be to my interest that you suffer as little as possible, and to the honour of my profession if you survive the operation. If you recover, you are granted a free pardon unless you repeat your crime of murder and brutal violence."

We must first call attention to the words which we have

italicised, and which the authoress coolly puts into the mouth of a doctor.

We next point out that the esoteric object of this strange proposal is doubtless to bring physiological experimentation into contempt and hatred. Experimentation on human subjects would be useful only if the question were to decide as to the practicability of some newly-projected operation. In other cases they might be perfectly useless. The writer before us, like many of her colleagues, conceives of experimentation from a simple and directly medical or veterinary point of view. The experimentation on animals, for which we contend, has for its point of view pure research in general physiology. But, even with the narrower object of direct medical or surgical application, the proposed experimentation on criminals would break down. Let us consider the recent researches of Pasteur on rabies, which have been of late so signally verified.

He found that the poison of rabies, if introduced into an animal of a given species, and transferred from that specimen to another of the same species, becomes attenuated, whilst, if passed through a series of another kind, it retains its virulence. How could he have discovered this capital fact if his experiments had been confined to one only species—human subjects? Again, condemned criminals are few, and are not always to be had when wanted.

To take a very different question, it is desirable to ascertain the influence of different kinds of water—within the limits actually occurring in nature—upon fish. Do they thrive better or worse in hard or in soft water, in waters holding in solution salts of lime or magnesia, in slightly brackish waters, &c. Such investigations are needed from a double point of view, both as regards the multiplication of food-fishes and to ascertain the influence of such conditions upon the formation of varieties, and ultimately, perhaps, of new species. Now, if experiments are to be performed on man only, how could such and hundreds of other researches be performed? Perhaps it may be argued that such experiments are not "vivisection." Logically they certainly are not. Legally, *i.e.*, within the meaning of the disgraceful "Anti-vivisection Act," they probably are. At least, certain physiologists about to engage in such researches have been advised by counsel that it would be prudent to obtain (if they could) the usual license under the Act.

But the writer warms to her subject. "Personally speaking I believe animal vivisection to be worse than useless; it is misleading and wholly sinful—an abomination in the

sight of God. I believe all the passions are sisters, and the lust of cruelty is one which in all ages has had its safety valve, always in a virtuous form, always protected by existing governments, the same as other things, whether it was throwing Christians to tigers in the arena after a Pagan feast, or the Holy Inquisition, or vivisection. Education and civilization have swept away all the other sorts except this last, and the day is not far distant when the world will be ashamed of this as of the others, and will look upon operators (whose names, addresses, and exploits are handed down to posterity in a directory published in Victoria Street, London) with the same eyes and feelings as if they were executioners or inquisitors, and their memory will be as those."

Surely a more foully and falsely libellous passage was never penned! It is a falsehood to say that experimentation upon animals is a "safety valve" for the "lust of cruelty."

The feelings of the experimentalist are just the same in the physiological as in the chemical laboratory. It is not his object to give pain, and in those cases where it might occur it is rendered impossible by anæsthetics. If a man take any delight in torture, he can indulge this feeling to the full without licenses, without anæsthetics, so long as his object is not scientific. So the "passions" are sisters? What, then, of the passion for "profligate lying" to which Mr. Robertson refers as a Bestiarian characteristic? Again physiological experiments are not "protected" by the British government: they are rendered all but impossible. Further, experimentation on animals—if it be cruel, which we deny—is not the only "sort" which has not been swept away. "Sport," in all its forms, exists practically unchallenged, and inflicts tenfold more pain upon animals than is done by "vivisection." As to the Victoria Street Directory, we know that the world will recover from its temporary fit of madness; the names enrolled in that directory will be honoured as those who upheld the cause of science amidst insult, obloquy, and positive persecution, whilst a wiser posterity will rank the Bestiarian advocates with Caccini and Scioppius, or with the monks who tore Hypatia to pieces, and who destroyed the Alexandrian library.

Vilification through every possible channel has been throughout a favourite weapon of the Bestiarians. We have received anonymous letters in abundance, rich in insults and threats, but never containing anything worth the name of argument.

But we will not drag our readers any further through this writer's outbreaks, vitiated as they are by the fundamental assumption that to inflict pain in pursuit of knowledge is "murder in the second degree," whilst under other circumstances it is lawful, or at least venial. Will the time ever come when the "emancipation" of vegetables will be as furiously advocated?

V. FROM THE DEBATEABLE LAND.

DEBATEABLE LAND? Between the physical and the psychical, possibly the metaphysical. We feel it our duty to notice certain experimental results obtained by eminent men, surrounded by sceptical witnesses, and employing all the precautions which science can suggest. Yet the phenomena obtained were of such a nature that unless some subtle source of error is detected we must await an important extension, and perhaps a rectification of our knowledge not merely in biology, but also in chemistry and physics. Let us venture to say that the new discoveries awaiting us seem likely to reinforce certain views still received by official savants with ridicule or with the conspiracy of silence.

Most of our readers will have heard of, perhaps witnessed, the experiments which some time ago were frequently exhibited under the absurd name of "electro-biology," which has since been modified in certain quarters into "biology." Without describing the well-known *modus operandi* in these performances, it will be sufficient to say that the subject was, for the time being, completely governed by the mind of the operator. If the latter handed him a lump of tallow, with the assurance that it was a piece of sugar, or a peach, the subject ate it with evident relish. We once witnessed an experiment where such a subject, an unwholesome-looking lad, was told that he was in a dark cellar. Although the room was brilliantly lighted, and though a candle was held close to his face, yet the pupils of his eyes remained widely expanded, like those of a person in utter darkness. We accepted this phenomenon as proof that the lad was not a

confederate, as we had previously had the opportunity of observing that before he was thrown into this state the pupils of his eyes expanded and contracted in the ordinary manner according to the degree of light. It must be noted that this peculiar state, however it may be explained, soon passed away, the operator retaining no prolonged control over the subject.

Recently, however, this process of—shall we say hypnotising?—has undergone further developments at the hands of Dr. Charcot, of the Salpetriere, and results of a most curious character have been reached. The influence, or delusion, does not pass away in the course of a few minutes, but may continue after the subject has left the presence of the operator, and extend to the next day, possibly longer. A person who has been thrown into this state may be told to go the next day and shoot a person, some acquaintance, and then give himself up to justice. It is impressed upon him that he is to do this, not in obedience to the operator's command, but purely of his own motion, whether out of revenge for some imaginary insult or injury, or out of mere "superfluity of naughtiness." There can be no necessity for us to describe the experiments of this kind which have been performed, since accounts of them have been, and still are, "going the round of the papers." Still less need we enlarge on the possible moral results of such an ascendency acquired by one person over the mind of another. But a point at which we must briefly glance is their bearing upon the question of free will. A subject who has been thus impressed goes and commits some crime. He feels that he is doing this wickedness, not at the command of the operator, but of his own motion. Yet, in reality, he has not been in this action a free agent at all, but a mere puppet, a machine performing the will of another, and yet retaining the belief in his own freedom and responsibility! Who can help asking, What, then, becomes of the doctrine of free will altogether? Who does not further feel anxious to learn whether there may not be other conditions in addition to that of hypnotic trance in which human beings may be subjugated by a foreign will whilst retaining a firm belief in their free agency. Experience seems to tell us that such is the case. Witness the manner in which weak-minded and impressionable people—it must be remembered that Dr. Charcot's experiments succeeded only upon certain individuals—are not merely carried away for the time being at "mass meetings," revival meetings, &c., but are controlled in their subsequent conduct. This control they

fancy is due to a rational conviction, whilst in most, if not all cases, it is an influence not depending upon reason but upon emotion. To give instances would be out of the question in an organ like the "Journal of Science," which has nothing to do with sects and parties.

Dr. Charcot's hypnotism differs from the primitive "electro-biology" in that the subject executes the commands or suggestions of the operator, not during trance, but in what he supposes to be a normal state. It agrees with hypnotism in the control of the operator over the subject, and in the circumstance that out of a number of persons experimented upon but few are found distinctly susceptible. Those most susceptible are generally more or less of a hysterical temperament.

This circumstance links the above-mentioned phenomena to a class of results obtained by Drs. Bourru and Burot, of the Naval Medical College of Rochefort, and recently described by them at the Grenoble meeting of the French Association for the Advancement of Science. They have found that, upon hysterical subjects at least, various medicines act not only without being swallowed, but even without being touched. We are thus reminded of some of the most ridiculed results of the late Baron Reichenbach. One of the subjects of these experiments was a young man, of feeble constitution, admitted at the Rochefort Hospital on March 27th, and who has since been attacked with a series of hystero-epileptic crises, upon which he became paralysed and insensible on the whole right side of the body.

In presence of this paralysis, the hysterical character of which was not doubtful, the first care of the observers was to try the action of metals. Zinc, copper, platinum, and iron were distinctly active, though in unequal degrees. The effects of gold were particularly striking. Not only did any article of gold, on contact with the skin, produce an intolerable burning, but even at a distance of 10 or 15 centimetres the burning was felt, *through the clothing and through the closed hand of the operator.* The mercury in the bulb of a thermometer, if brought near his skin, but without contact, occasioned burnings, convulsions, and attracted the nearest limb. Chloride of gold, in a stoppered bottle, if brought within a few centimetres of the man's body, produced effects very like those of metallic gold. On bringing near the subject a crystal of potassium iodide, there resulted yawning and repeated sneezing. There was thus the well-known physiological action of this salt in irritating the mucous membrane of the nose. The observers were still

more surprised to find that opium made the patient sleep by its mere proximity.

These facts were so strange that the observers did not at first feel free to make them known, scarcely believing the evidence of their senses. The experiments were repeated in presence of various colleagues, who were admitted not merely to observe, but to devise the most varied and difficult counter-tests.

After some months of observation and of prudent reserve MM. Bourru and Burot met with a second hystero-epileptic subject, who gave the same reactions as the former. This patient was a woman, aged 26, insensible over the whole right side of the body, but excessively sensitive on the left. The results with the two subjects were essentially identical.

The observers requested Dr. Duplouy, Director of the Naval Medical College of Rochefort, to be present at a check-experiment. This gentleman, being absolutely incredulous, demanded the most rigorous conditions. All persons who could influence the subject had to be removed, and an absolute silence was maintained. The experiment was made in the presence of the director, the professors, and assistants of the College, and a great number of naval surgeons and pharmacists. The scientific authority of this assembly was of the greatest importance. The experiments were decisive, conclusive. A bottle containing jaborandi, brought by an assistant, was placed near the patient by another person, and immediately occasioned salivation and sweating. An experimentalist, having in his pocket two bottles of the same size, both wrapped in paper, and wishing to put the patient under the influence of cantharides, found him behave as if affected by valerian. The experimentalist was surprised, but every one saw, on removing the wrapper, that instead of presenting the bottle of cantharides, as he had intended, he had presented the other, which in fact contained valerian. All the spectators were satisfied, and Dr. Duplouy declared openly that he was convinced in spite of himself.

Afterwards one of the two subjects was transferred to the asylum of Lafond, at La Rochelle. Here Dr. Mahlle repeated all the experiments, and vouched for the accuracy of the results in communications to the Society of Medicine and the Society of Natural Sciences at La Rochelle.

Into the methods of experimentation which these physicians finally adopted we cannot enter; nor can we give the details of the action of the different drugs tried.

Alcohol from different sources occasioned very distinct effects. The alcohol of wine in different forms always

induced a gay drunkenness. Alcohol from grain, on the contrary, occasioned a furious intoxication, and a true scene of rage. Absinthe produced paralysis of the legs.

Cherry-laurel water occasioncd in the female subject phenomena so surprising that they were repeatedly studied and scrutinised in detail. There was at first a religious ecstasy, which set in almost instantly, and which lasted more than a quarter of an hour. Some seconds after the application of the substance her eyes were turned upwards, her arms rose up slowly, her hands were extended towards heaven, her figure seemed to respire beatitude. She fell on her knees, with her head bowed down in the attitude of prayer. Soon she prostrated herself in adoration; she wept, with her head touching the earth. Convulsive movements of the thoracic muscles and the diaphragm follow, succeeded by a calm sleep.

When the subject was again under the influence of this hallucination she was somnambulised, and asked what she had just seen? She replied that she had seen the Virgin Mary, clad in a blue robe with stars of gold. The Virgin had reproached her for her disorderly life, told her to pray for a change of conduct, and finally gave her benediction. When awake the woman, who is a Jewess, scoffed at all mention of the Virgin. This experiment was repeated many times, always with the same result. On scrutiny it was found that the laurel-water contained both prussic acid and the volatile oil of laurel. The prussic acid, used alone, determined thoracic convulsions without visions; the volatile oil brought on the vision alone without convulsions.

Nitro-benzol was next tried: it occasioned convulsive shocks in the entire body. There was then observed a rhythmic trembling in the right arm, which was uplifted as if the patient was executing a drawing. She said afterwards that she had been sketching.

In the male subject laurel-water did not occasion ecstasy, but immediate thoracic convulsions, hiccup, and salivation. The volatile oil of laurel occasioned excitement without ecstasy. Nitro-benzol brought on convulsions of the arms, and the same hallucination of sketching or drawing.

Valerian, generally considered as a sedative, occasioned in both subjects a violent excitement, with odd phenomena analogous to those which it produces in cats.

In all these phenomena the authors distinguish psychical actions, consisting in a variety of hallucinations probably specific to each subject, and physical actions, the chief of which are salivation, vomiting, intestinal contractions,

sneezing, yawning, sleep, sweat, affections of sight, and alcoholic stumbling.

Observations have also been made upon a number of patients less sensitive, and the results obtained, though less decided, were confirmatory.

A hysterical patient has been thrown to sleep by placing in her hands a bottle of chloral hydrate. A hystero-epileptic patient, in the care of M. Dumontpallier, was sent to sleep by the approximation of opium. In M. Charcot's ward a woman submitted to the contact of alcohol displayed obstinate drowsiness, tottering, heaviness of the head, a moderate pleasant drunkenness, and then vomiting,—symptoms which were removed by ammonia.

Another hystero-epileptic woman was instantly affected by alcohol, feeling heaviness in the head, intense stumbling, and repeated efforts to vomit. A patient in Dr. Brouardel's ward was affected by alcohol chiefly in the legs, and could not remain on her feet.

Though such decided effects were produced only in a small number of cases, we may believe that an influence, however slight, may be occasioned in most hysterical subjects.

The authors by no means profess to explain these "almost supernatural" facts. They consider that three theories may be put forward: (1) the theory of suggestion; (2) that of vibration: and (3) that of radiating nervous force, or, rather, of a nervous field.

The first theory is incapable of accounting for the facts, especially for that case where a person presented to the patient valerian, believing that it was cantharides. The results, however, were not those of cantharides, but of valerian.

The theory of vibrations, already put forward by M. Vigouroux to explain the action of the magnet, might be also discussed and appropriated to these facts, but it appears quite insufficient. M. Vigouroux himself avows that this idea of vibrations offers us a means of comparison and of schematic representation, but not explanation. He adds that in the present state of Science it is no explanation to say that a phenomenon is of a vibratory nature, for everything is vibratory.

Finally, there remains a third theory, that of radiating nerve-force, developed by M. Baréty, at Nice, in 1881. The idea of the exterioration of the nerve-fluid to a distance presents powerful analogies with certain well-known physical facts. A globe of hot water radiates heat; a magnet

has its magnetic field. The force accumulated in these apparatus radiates outward, and bodies which are found within a given radius undergo its action. It is true that, if a nervous force is suspected, its existence is by no means demonstrated. But it is as impossible for the physicist to prove directly the existence of the ether as it is for the physiologist to prove in a direct manner the human [better, animal] nervous field. We suspect the existence of the ether from its effects; we admit magnetic forces at a distance without seeing them, by observing that iron placed at a certain distance is attracted. In the same manner, if it be proved that a substance acts upon the human body at a distance, there must exist a something which is impressionable. This impressionable zone will be manifest only in those conditions of development of nerve-force which are peculiar to hysterical subjects. In these conditions the phenomena of medicines acting at a distance is easily explained: they are at once plunged into a nervous zone which they impress by determining special physiological actions, mostly of the nervous order.

The discovery of MM. Bourru and M. Burot is full of consequences in the sphere of physiology and psychology, and it is impossible to foresee to what it may lead.

VI. ON THE IRRECIPROCAL CONDUCTION IN THE ELECTRIC ORGAN OF THE TORPEDO.

DURING the years 1883, 1884 and 1885, Prof. Du Bois Reymond has had repeated opportunities of examining living specimens of this singular fish, and has communicated his results in the "Transactions of the Berlin Academy of Sciences" ("Sitzungsberichte der Berliner Academie der Wissenschaften," 1885, p. 691) and the "Naturforscher." Notwithstanding the much enfeebled and consequently inefficient state of the fish, he succeeded, by means of skilfully arranged investigations, in establishing a series of facts which are a very important contribution to the full understanding of these mysterious electrical organs. We shall, for the present, consider only one of his results —the irreciprocity of the conduction in the electrical organ.

On examining the phenomena of polarisation presented by the electric organ when traversed in rapid succession by currents of brief duration passing alternately in the same direction as the animal's own current, from the belly to the back (or, as Professor Du Bois Reymond calls them, homodromous currents,) and in the opposite direction (heterodromous currents, the preponderance of the former (homodromous) was found most decisive. The thought immediately suggested, of an unequal conductivity of the electric organ for currents of the same and of an opposite direction, seemed to require a definite experimental investigation. In the first place it was necessary to decide whether the stronger action of the homodromous current as observed was merely apparent, or really existing.

The first observation made on the more precise observation of this phenomenon was its very striking dependence on the density of the current. If the opening shocks of a sledge-induction-apparatus (the primary coil being filled with rods of iron) were passed through the preparation from one skin-surface to the other, alternately in a homodromous and a heterodromous direction, the deviations of a galvanometer placed in the same circuit were greater with homodromous than with heterodromous currents. The ratio of the heterodromous to the homodromous deflections was = 100 : 224·7, if the distance of the secondary from the primary coil was 0; if this distance was 10 centimetres the ratio was = 100 : 105·1, whilst at a distance of 15 centimetres the ratio became 100 : 100. From the experiments, of which the figures quoted form merely a specimen, it follows firstly that the phenomenon becomes perceptible only when the strength of the current passes a certain limit, and secondly that the irreciprocity increases with the strength of the current, though more slowly than the density.

It was further established by experiment that the difference in the strength of the currents becomes visible not only when they are passed from one polar surface of the preparations (covered with skin) to the other, but between any given points of the lateral surfaces of the preparations, the more strongly the more remote from each other the points are situate.

If induction currents were passed to the lateral surfaces of the preparations by means of unpolarisable electrodes, the heterodromous deflections in a long layer of the organ were to the homodromous as 100 : 39·1; in one of medium length as 100 : 45·8; and in a short distance only as 100 : 78·4.

The irreciprocity was therefore the greater the longer the part of the electric organ traversed.

But, decisively as the experiments here referred to seem to support the irreciprocity of the conduction, Prof. Du Bois Reymond considered it as not yet demonstrated. The phenomena might possibly, though very improbably, depend on polarisation. But, without reference to the interpretation, it was important to effect a direct measurement of the conduction of the electric organ, and to compare it with that of other tissues.

According to a method which Professor Du Bois Reymond had formerly used for determining the resistance of the muscles of frogs, he compared with each other the conductive power of a solution of common salt at ¾ per cent; of sea water, of the muscular flesh of a frog, and of the organ when traversed by a homodromous or heterodromous current. All these were, in succession, placed in one and the same tube, and introduced into the same circuit. It appeared that the electric organ of the torpedo, in a homodromous direction, conducts twice as badly as frog muscle parallel to the fibres, and from 7·5 to 12 times worse than the sea water of the aquarium. In the heterodromous direction the organ conducted 20 to 58 times worse than sea water. Experiments were made on the conductivity of the organ in a transverse direction, induction shocks being transmitted sometimes from the belly to the back, sometimes from the back to the belly, and sometimes transversely from one lateral margin to the other, *e.g.*, in the homodromous direction 80·7, in the heterodromous 22·5, and transversely 99 degrees of deflection. When the lateral margins were covered with skin in order to equalise the conditions as far as possible, there was obtained a deflection in the transverse direction of 95 degrees of the scale either with or without skin, in the homodromous direction without skin 75 degrees, and in the heterodromous condition, likewise without skin, 18.

The low conductivity of the organ, and its irreciprocity, depend, as further experiments showed, on life. If the tube, filled with the columns of the organ, was plunged for a few minutes into boiling water, the conductivity of the organ was increased. Its resistance in both directions was now equal, and was smaller than the smallest resistance in the homodromous direction, smaller even than that of the physiological saline solution. The same increase of conductivity, and the simultaneous decrease of irreciprocity, occurred on the spontaneous death of the organ, so, after

decomposition had set in, the conduction in both directions was equal.

From these facts Professor Du Bois Reymond infers that the existence of irreciprocal conduction in the electrical organ may be regarded as established. But, as all the experiments showing the irreciprocity of the conduction had been performed only with induction shocks, or with battery currents of brief duration, experiments were now made with the currents of a Grove's battery, and the circuit was kept closed so long as was possible without a too great disturbance by heating, polarisation, &c. The result was that with a prolonged closing of the circuit no irreciprocity of conduction appeared, though during a momentary closing it was very strong and even; if the circuit was kept closed for a second it was decidedly weaker. There can be therefore no doubt that the irreciprocal conduction of the organ depends both on the density of the current and on its duration. The homodromous resistance is independent of the density and the duration of the current, whilst the heterodromous resistance with currents of low density does not greatly differ from the homodromous. But when the density has reached a given limit value the heterodromous resistance becomes greater the greater the density and the briefer the duration of the current. Probably as the density of the current increases it reaches an upper limit, and with the increasing duration of the current a lower.

As to the cause of the phenomenon, it is for the present impossible to form a satisfactory conception. It seems as if the heterodromous current, as soon as its density in the preparation exceeds a certain value, the "limit-value," encounters a peculiar resistance, to overcome which a certain time is required. This supposition would explain why, in the case of brief currents, the irreciprocity of the current is strongly manifested, whilst little of it appears in case of prolonged currents.

But, though the irreciprocal conduction of the electric organ has not as yet been traced to its cause, it is very interesting to note that this phenomenon plays a not unimportant part in the economy of the stroke of the torpedo.

If we conceive a single column of this electric organ as surrounded by an infinite, conductive mass, we may design the curves of the current with which the space is filled by this current. They pass symmetrically to the axis and to the transverse median plane. Current nerves issue not only from the positive hinder surface of the column, but also from the lateral surfaces above the median plane, returning

below it to the lateral surfaces, whilst those issuing from the back-surface return to the belly-surface. Within the columns there is a current from the belly to the back. If we now suppose that in the conductive mass there are, besides the first column, other similar columns with parallel axes, the lines of the current in any given surface-element of the external space are compounded according to the parallelopipedon of forces. But, as each column represents for all the others a portion of the external space, each is traversed in a heterodromous direction by a portion of the current-lines of all the others.

For any given part of the external space the other columns form, for the lines of current impinging upon them, a by-circuit. The worse this conducts the stronger are the currents passing through the portion of space in question. If we imagine all the other columns insulating, the action of the one column upon the part of the external space in question will be strengthened.

[It will be well to bear in mind that the word "column" as here employed signifies a galvanic combination, and is used as being less misleading than "battery."]

The electric organ is not, indeed, an insulator, but it possesses, as the above-mentioned investigations show, the power of irreciprocal conduction. The current-lines are all, where they impinge upon the organ, heterodromous. Consequently they encounter in the organ a resistance which has practically the same effect as if the organ were a non-conductor. In virtue of irreciprocal conduction there occurs the remarkable phenomenon that each column conducts its own homodromous current relatively well, but blocks the way for the heterodromous current-lines of all other columns.

As this applies to all the columns, the current-lines of all are compelled to take the circuitous route round the edges of the electric organ. The total current in the external space consequently increases in density or in physiological action.

The concluding observations of Professor Du Bois Reymond are here given verbatim:—

"I formerly succeeded, when examining the electrical fishes, in detecting surprising instances of that organic purposiveness which fills anew even the strict adherent of mechanical causality with astonishment. I showed how the form of the electric organs of the torpedo on the one hand, and of *Gymnotus electricus* and *Malapterurus electricus* on the other, is adapted to the different conductive power of sea-water and fresh water; how, during the growth of the

gymnatus and the torpedo the electric organs are developed in the very directions which fresh water and salt water respectively require; how the electro-motive forces of both these fishes are found, on measurement, to be approximately what the resistances of fresh water and of salt water require; how the positive polarisibility of the organ is adapted to increase the stroke by rapidly succeeding shocks, whilst the negative effects by tetanisation, the object that a new discharge begins again almost from null. I proved the necessary immunity against electric shocks possessed by these fishes and their spawn. Lastly, the remarkable nerve tufts discovered by Wagner in the organ of the torpedo seemed possibly to have the power of causing all the electric plates innervated by the same primitive nerve fibre to come simultaneously into action. In one point only we failed to understand the arrangement of the electric organs of the torpedo: the part of the external space above the back of the fish, bordering on the sagittal plane, though most in need of protection, seemed to us, in the language of military engineers, a "dead angle." This evil is, to a certain extent, undoubtedly obviated by irreciprocal conduction."

"However this may be, the instance of internal purposiveness which we have found surpasses in ingenuity, so to speak, all the former. It would certainly have required the most profound meditation of a gifted thinker to suggest the idea of making each column a good conductor for its own current as far as the general properties of animal tissues permit, but comparatively a non-conductor for the current of all other columns. Not the least clever point is that since the shock of the electric fishes is quickly transient the organ conducts irreciprocally only brief currents. These would have no use in rendering it a perfect non-conductor for permanent heterodromous currents.

The distribution of electric force in the organic world is a mystery. We have an electric plant, an electric bug, an electric slug, and three electric fishes. Why this power should not occur in other forms of life is not understood.

VII. ACCLIMATISATION FROM ANOTHER SIDE.

SOME months back a paper on "Acclimatisation" was laid before our readers.* In it the author contended that the introduction of an alien plant or animal into any country was, from the point of view of organic geography, a mistake, as rendering it sometimes difficult to ascertain its indigenous flora and fauna. Economically considered, it is still more objectionable if the introduced species are weeds, granivorous birds, or mammals capable of maintaining themselves in a feral or semi-feral state, not to speak of death-snakes or beasts of prey. This subject derives an additional importance if we remember that there is in England no distinct law against importing and turning loose rattle-snakes, wolves, jaguars, &c.

But the introduction of useful and beautiful plants stands on a quite different footing, and, if scientifically carried out, may not merely prove a public benefit, but may throw light upon the part taken by natural selection in the origin of species.

But, unfortunately, the introduction of new plants has been hitherto attempted in a manner anything but scientific. At present plants from regions not differing too widely in temperature from that of England are introduced, and attempts are made, after a fashion, to accustom them to our climate. They are set in places sheltered from northerly and easterly winds, and freely open to the sun; and they are protected by means of matting and other devices in cases of severe frost. Or otherwise they are raised in a cool greenhouse, moved into the open air in the summer, and left out year by year, as they grow stronger for a greater length of time.

But there seems to have been no systematic attempt to conduct the acclimatising process on the principle of selection. Our florists and nurserymen apply this principle most thoroughly in their attempts to produce new flowers or new fruit trees. When a bed of young plants has come into bloom, or a plot of young trees, be they pears, plums, or what not, has fruited for the first time, they are "rogued."

* Journal of Science, 1885, p. 205.

That is, all those which yield an inferior flower or fruit are pulled and thrown on to the rubbish heap, the superior varieties only being preserved. Perhaps one in a hundred is thus permitted to survive and is used for propagation.

But the same horticultural authorities do not seem sufficiently alive to the fact that among a large number of seedlings some may be superior to the generality in their power of resisting low temperatures. We learn from Mr. Jenner Weir, F.E.S., a most observant naturalist, that a great number of begonias, which the grower had intended to house for the winter, were overtaken by one of the morning frosts which have occurred so unseasonably in the present autumn. All the begonias, save one, were cut off. It becomes now exceedingly probable that if young plants were propagated from this resistant individual some one or more of them would be found still hardier than the parent, and thus, by a process of selection, we might, in the course of successive generations, arrive at a strain of begonias, and in like manner of other greenhouse plants, which should flourish in the open ground.

By a similar process of selection we might seek to produce fruit trees, which should come into blossom later than the ordinary strains, and thus escape the destructive action of spring-frosts. It would, of course, be needful to aim at the production of strains which mature their fruits in the shortest time. Of course the essential question, only to be determined by experience, is whether the power of bearing low temperatures, of blossoming late and yet ripening fruit early, can be obtained without a sacrifice, greater or less, of the valuable properties of the various fruits. But in so untrustworthy a climate as ours, where a temperature of 24° F. may be experienced as late as May 8th, the development of such strains or varieties should be aimed at if our soil is to yield its cultivators due remuneration.

VIII. THE CAUSE AND THE PURPOSE OF THE LUMINOSITY OF MARINE ANIMALS.

IN the opening address delivered by Prof. H. C. McIntosh before the Biological Section of the British Association the phosphorescence of marine animals was discussed at some length. The author gave an enumeration of the various groups of animals possessing this power, and described the manifold phenomena manifested. In conclusion he took into consideration the cause and the purpose of this phenomenon.

As he remarked, in the Protozoa the structure of the minute, and often very numerous, creatures which evince phosphorescence shows plainly that the presence of a definite nervous system is not necessary for its manifestation. The protoplasm of their body is itself sufficient for its production. Here there are no glands for the secretion of luminous substances, and in many there is evidently no fat which might undergo slow combustion. In the Cœlenterata the phenomenon seems to stand in close relation to nervous processes, though in certain cases the luminous substance possesses quite peculiar properties. Whilst in certain Annelida, such as *Chaiopterus* and *Polyerrus*, there exist glands which may effect the secretion of a luminous substance in certain Polynoides, the emission of light seems to be due to a peculiarity of the nervous system. The irritability in the phosphorescent species of the latter family fluctuates greatly, some—*e.g.*, *Polynoë scolopendrina*—being sluggish, and others, on the contrary,—like *Harmothoë*,—exceedingly sensitive. In the Crustacea the luminous property seems to possess the character of a secretion, which is probably under the control of the nervous system. In *Pyrosoma* and *Pholas dactylus* a luminous secretion is a prominent attribute; and in the latter, as in the Annelida, death occasions its manifestation, which, to a limited extent, holds good in fishes also.

It is hence plain that the cause of phosphorescence is complex. In one group of animals it is derived from the formation of a substance which can remain behind like a luminous trail. The ease with which, in *Pennatula* and and other Cœlenterata, phosphorescence can be repeatedly

elicited by rubbing the surface, which contains a minute trace of the luminous matter, points decidedly to other causes as co-operating. This function is plainly referrible to the organic chemical affinities of the tissues concerned. On the other hand, in certain Annelida it is a purely nervous activity, probably of kin to that which produces heat.

With the exception of Macartney, former authors have generally sought to connect the emission of light with the peculiar conditions of the depths of the sea. It was assumed that total darkness prevailed at the depth of 1000 feet, and that the phosphorescence of marine animals was for them a substitute for the light of the sun. It was further supposed that these lights were a guide to animals in seeking and attacking their prey, whilst, on the other hand, the power of withdrawing their light enabled them to escape dangers. It is well known that fish prey by night, and it was assumed that they were guided by the phosphorescence of their booty, since the light is particularly strong in those low animal forms which, by reason of their astonishing reproductive powers and of their dull sensibility,—little exceeding that of plants,—seem to be especially created for the nutriment of the higher forms. But with such theories great caution is necessary.

In the first place, the phosphorescent animals do not seem to be more numerous in the depths of the ocean than between high and low water-mark, or on the surface. On the contrary, the surface probably displays the greatest development of luminous species. Very many young animals which are said to phosphoresce strongly become surface-forms soon after leaving the egg, and people thus in their different stages all three regions,—the surface, the mean depths, and the abysses.

An examination of the life-histories of several phosphorescent groups does not supply any useful data for establishing a theory of the function of phosphorescence, especially with reference to nutrition. No phosphorescent form is more generally devoured by fishes and other animals than those which are non-phosphorescent. On the other hand, forms endowed with luminosity, if otherwise eatable, do not seem to escape capture. An examination of the stomachs of fishes proves this clearly, except perhaps the herring, which is pre-eminently a surface-fish. It is also not proven that such animals are always luminous, for many display a light only on irritation.

The irregularity of the appearance of phosphorescence in animals which agree in every respect in structure and habits

further supports the view just put forward. Thus from the time of Pliny it has been known that *Pholas dactylus* is luminous, whilst the common *P. crispata* does not possess this property. Two Annelida, *Harmothoë imbricata* and *Polynoë flaccosa*, are both very common between high and low water-mark: they closely resemble each other in their habits and in their appearance, but the one is brightly luminous, while the other has not a trace of this property. Instead of enticing other animals as their prey, or of being themselves more readily captured, the phosphorescent Annelida are often inhabitants of tubes or guests of star-fishes. In fact, in the various groups, we find every variety of vital conditions combined with the presence of phosphorescence, so that the greatest care must be taken in drawing conclusions if they are to be of general applicability.

ANALYSES OF BOOKS.

The Wanderings of Plants and Animals from their First Home. By VICTOR HEHN. Edited by JAMES STEVEN STALLYBRASS. London: Swan Sonnenschein and Co.

THE title of this work raises expectations which the very first sentence of the Preface scatters to the winds. We hoped for a body of research showing how animal and vegetable species spread out from the point of their first appearance to the regions which now they occupy,—in short, for a work which should be the complement of Mr. A. R. Wallace's "Geographical Distribution of Animals." Such a task the author and the editor do not for a moment think of undertaking, and we trust they will pardon us for remarking they have not the necessary qualifications. We are told by the editor that "the history of our Domestic Animals and Cultivated Plants is a subject of absorbing interest to the educated man," and this history, accordingly, would seem to be the subject-matter of the book. But we find not a few of the most important cultivated plants omitted. We need merely mention as instances the tea-, coffee-, and cacao-trees, the various species of Cinchonas, the clove and the nutmeg and the vanilla plant, the yam and the banana. All these are important agriculturally and commercially, and all have spread over wide regions of the earth. Yet, from whatever reason, they are here overlooked.

On the other hand, we find mention of animals which are not domestic, and which follow man's footsteps much in the same manner as do epidemics. As instances we may take the mouse and the rat. But why, if these mischievous rodents are introduced, does the author keep silence on the wanderings of the bed-bug and the cockroach, which have now established themselves in all civilised countries; of the Termites, one species of which at least has become naturalised in South-western France; or of the house-flies and blood-sucking gnats, which, as Baron Osten-Sacken shows, have within comparatively recent times spread into regions where they were formerly unknown. In short, it is not easy to give the author's point of view in a few words. We may come nearest to the mark by saying that Herr Hehn confines his attention essentially to animals and plants which have been introduced by human agency into Europe.

We turn now to the author's method. He, or perhaps Mr. Stallybrass, expresses the opinion that questions as to the origin

of animals are "susceptible of two or three different methods of investigation, which sometimes clash, and lead to opposite conclusions. . . . Our answers to these questions will be different, accordingly as we lean chiefly on Natural Science, or on Ancient History, Literature, or even Language. *The purely scientific man will judge chiefly by the suitability of soil and climate.* If he finds a plant flourishing pretty abundantly in Greece or Italy now, and knows of no climatic or geologic changes that would exclude the idea of its having flourished there 5000 years ago, he will at once pronounce it indigenous, and scout the notion of its having been imported."

This passage, and especially the words which we have italicised, is a complete misconception. The "purely scientific man" does not "judge chiefly by the suitability of soil and climate." He knows, as one of the most elementary truths in organic geography, that soil and climate form merely the exclusive limit to the existence of any given animal or plant; *i.e.*, if they are unsuitable such animal or plant will be certain not to exist, but it does not necessarily flourish where both are suitable. If he were to find, *e.g.*, a humming-bird in New Guinea, a bird of paradise in Venezuela or Trinidad, a squirrel or a deer in Australia, or a kangaroo at the Cape, he would at once pronounce it imported. The scientific method of deciding whether a species is indigenous or alien in any country is not so simple as Messrs. Hehn and Stallybrass seem to imagine. We examine, first, whether such species stands alone, or is found along with other species of the same genus, or of other nearly allied genera. In the latter case the probability of its being a rightful native is very strong. We next consider whether there are in the country concerned other animals, not near of kin to it, but capable of replacing it in the economy of Nature. Thus the occurrence of carnivorous Marsupialian forms in Tasmania, such as *Thylacinus* and *Dasyurus*, renders the indigenous existence there of placental Carnivora less probable. In like manner the rich development of antelopes in the Ethiopian region confirms the non-existence there of true deer. Hence if we found an apparently feral deer at the Cape we should feel all the more disposed to view it as imported.

Another consideration is the existence or non-existence of the species in question, in some region connected with the country under examination, by lands through which migration could have taken place. Thus, should a bear be captured in the Ethiopian region, we should hold it as having been imported, because the regions inhabited by bears are severed from Central and South Africa either by the ocean or by wide deserts.

The last main method of ascertaining whether an animal is indigenous in any country or not is the palæontological. If we find its remains in numbers in bone-caves, peat-beds, kitchen-middings, &c., and if, on penetrating into older strata, come upon traces of allied forms, we feel free to pronounce it indigenous.

The author and the editor of the work before us seem in great measure to repudiate these biological and geological methods. They think that "of late years the scientist has had too much his own way, that it is time for the historic and philologic methods to come into play and have their say."

We do not feel justified in a total repudiation of these methods. In doubtful cases they may turn the balance. Where more tangible evidence is wanting they may be precious. But we fear that, generally speaking, they are more apt to lead to ingenious speculation than to definite truth. The writer holds that if a plant is never mentioned by Homer, whilst later writers speak of it in a vague way, we may infer that the plant had been imported into Greece within historical times. To us this seems an unsafe inference. There is no necessity that every plant known, or even common in Greece, should be mentioned by Homer. If it is noticed more and more clearly by succeeding writers, this is likely to be due to the fact that, as agriculture, horticulture, and especially medicine, were more carefully studied, the flora of Greece, as of other countries, would certainly become more accurately known. Had early Greece possessed a work on *Materia Medica*, revised editions of which appeared every century, we should then have firm ground beneath our feet. But to estimate the fauna or flora of a country from mere literary productions, where the mention of plants and animals is merely casual, is certainly a rash procedure. What a grotesque notion should we form of the flora of England if we were to compile it from the writings of our poets, playwrights, and novelists!

As regards the natural history of the Mediterranean lands, we have often regretted that the botanical and zoological treatises of Solomon, mentioned in I. Kings, iv., 33, are not extant. In all probability they would have thrown an invaluable light on the origin and migrations of our domestic animals and cultivated plants.

Another difficulty besetting the literary and traditional method upon which our authors rely is the lack in olden times of a fixed nomenclature for natural objects. Hence the identification of animals and plants mentioned in the Greek and even the Latin classics, and in the Old Testament has been attended with no little unprofitable inkshed.

Another point must not be forgotten: when a people migrate into new abodes they frequently give to the plants and the animals of that region—perhaps nameless before—the names of the plants and animals with which they were familiar in their original seats. Of this we have abundant instances on the part of European settlers in America. In view of this trait of human nature the value of the philological evidence is greatly lessened.

To the naturalist the work before us must be pronounced of but small value, in virtue alike of its narrow scope and of its questionable methods. For the historian of culture, the ethnolo-

gist, and the philologian it will prove a treasure. In connection with these subjects we find not only wide and profound learning, but original and suggestive thought.

It may be strange, in a work bearing the title of that before us, to find an analysis of the causes which led to the overthrow of the Roman Empire. Thus Prof. Hehn writes:—"Another slowly operating destructive force, identical at bottom with that of Christianity, was the mixture of races, the intrusion of Oriental blood into the population of the West. . . . The rapid fall was only a consequence of the transformation of race. Natives of Africa and Egypt, Orientals of every type, European and Asiatic Greeks, Spanish Iberians, Illyrians, and Thracians deluged Italy, intermarried with each other, took possession of the organs of the State, of education, of literature, and not seldom even mounted the Imperial throne. As early as the time of Cicero and Cæsar all the cities, and Rome among them, were crowded with the circumcised, who were agreed among themselves; and however senseless and anti-human their opinions seemed to the Romans, yet with their stubborn bent of mind they imperceptibly revolutionised the general consciousness. 'Oh that Judea had never been subdued by Pompey and Titus!' exclaimed Rutilius Numatianus in his 'Itinerarium.' Thence comes, and now spreads far and wide, the infected matter, and those who were once conquered fasten the yoke on the necks of their conquerors!"

We may, perhaps, find here a trace of that Anti-Jewish movement which has of late made itself so conspicuous in Germany and the more eastern parts of Europe. However this may be, there is here matter which deserves to be heedfully studied by Cosmopolitans, Internationalists, and the advocates of "Miscegenation." It would almost seem as if, even without intermarriage, the intellectual and moral life of a people may be poisoned by the mere presence of aliens. Are we, in modern England, undergoing a similar progress?

We can recommend this work, not indeed to the naturalist, but, in return, to almost every one else.

Transactions and Proceedings of the Royal Society of Victoria. Vol. XXI., June 30, 1885. Melbourne: Mason, Frith, and McCutcheon. London: Williams and Norgate.

From the Anniversary Address of the President, Mr. R. L. Ellery, F.R.S., F.R.A.S., the Government Astronomer, we learn some satisfactory facts. The progress of botanical research is satisfactory. Baron von Müller has completed the tenth and last decade of his "Eucalyptography of Australia," and is issuing a Monograph of the Myoporinæ. He is also engaged

on a work of higher scientific importance, on the regional distribution of the 14,000 Australian plants.

The Natural History Museum, under the management of Prof. M'Cay, has received several very important additions, especially some collections illustrative of the Zoology of New Guinea, and a fine collection from Borneo.

The Field Naturalists' Club is prosperous, and numbers nearly 200 members. Let us hope that they will work energetically at the almost endless questions which are sure to crop up in a country so sparingly explored as Australia.

Earthquake tremors have been of late experienced in Tasmania, and in the extreme south-east of the Australian mainland. Most of the tremors and rumblings, whilst startlingly manifest on the surface, were not noticed 12 feet or more below it, except sometimes in the open-timbered shafts of the mines. Even in deep cuttings they were often not noticeable." This would seem to indicate that the agency concerned cannot be deep-seated.

Red sunsets and afterglows are still observed, but the Krakatoa theory is becoming discredited. It has now come to light that similar phenomena were not uncommon in Australia before that great catastrophe.

Much definite information has been collected as to the rainfall in different parts of Australia. Only a fringe around the great continent—broad in some parts and narrow in others—has a sufficient rainfall to render agriculture successful. The arid centre has an average rainfall of from 5 to 10 inches per annum, and it is a matter of surprise that vast flocks of sheep can be maintained in such a region. Between these two districts runs a belt with from 15 to 20 inches of annual rainfall, the limit required for wheat-growing.

The first article printed is "On the Evidences of a Glacial Epoch in Victoria, during Post-Miocene Times," by G. S. Griffiths. The evidence, which he collects from purely geological, palæontological, and biological sources, appears *prima facie* conclusive.

Mr. James Stirling, F.L.S., of Omeo, continues his Phanerogamous Flora of the Mitta Mitta Source Basin.

Mr. W. W. Culcheth, C.E., discusses the formation of shingle on the East Coasts of New Zealand with reference to keeping open harbours and river-mouths.

Mr. P. H. Macgillivray, M.R.C.S., F.L.S., continues his researches on new or little-known Polyzoa, in two memoirs, and he also contributes a paper on the "Reproduction of the *Ornithorrhynchus*."

Mr. James Stirling, F.L.S., gives an elaborate account of the Meteorology of the Australian Alps.

The Ocean, a Treatise on Ocean-Currents and Tides and their Causes, demonstrating the System of the World. By WILLIAM LEIGHTON JORDAN, F.R.G.S. Second edition, abridged and revised. London: Longmans, Green, and Co.

THE fundamental idea of this work is to be found in the fifth chapter, where we have an investigation of *vis inertiæ*. As it is well known, Newton defined *vis inertiæ* as "an innate force of matter or power of resisting, by which every body, as much as in it lies, endeavours to persevere in its present state, whether it be of rest, or of moving uniformly forwards in a right line." ("Principia, Book I. Definition III.).

Our author does not accept Newton's definition. He argues "that any bodies have an innate tendency to move uniformly forward in a right line is mere assumption. . . . It is said that, in the simple case of a ball, thrown in the air and rolled on the ground, being set in motion, its *vis inertiæ* tends to keep it in motion until it is stopped by the resistance of the air or the friction of the gronnd against which it runs. This is an error. It is not the *vis inertiæ* of the ball which tends to keep it in motion. It is *vis inertiæ*, and *vis inertiæ* only, which stops and must in time stop the cause of that ball. *Vis inertiæ* resists the motion of the ball from first to last. . . . It thus appears that if, in any body whatever, there be not some motive force acting continuously to keep it in motion, its own inherent power of *vis inertiæ* must (even if no other cause arise) in the course of time bring it to rest.

The difference between Newton and Mr. Jordan is easily seen. According to the former, *vis inertiæ* causes matter to persist in its condition, whether of rest or of uniform rectilineal motion. According to Mr. Jordan, *vis inertiæ* causes matter not only to remain at rest, but if set in motion to tend to a return to rest.

Our author views the tides and the earth's rotation as the main causes of oceanic currents, and of the trade winds. Starting with the experimental fact that if a vessel containing water is set in motion the water tends to lag behind, he applies this principle to the hypothetical cases of a globe entirely covered by water, of an ocean surrounded by land, and to the case, as we actually find it, of an ocean whose movements are more or less intercepted by continents.

CORRESPONDENCE.

SIR LYON PLAYFAIR'S PRESIDENTIAL SPEECH.

In your article on Sir L. Playfair's Address (p. 611) you make what seems to me a serious omission. The speaker, in his recommendations concerning higher education, proposed that while colleges for the middle class should give a training pre-eminently scientific, those for the youth of the "upper ten thousand" should still, as now, be mainly classical and literary in their teachings. I submit that so long as such an arrangement prevails Science will never take the rank to which it is entitled. It will be contended that if Science is unfit for a prominent place in the education of the higher classes, it is of course something of a second-rate, shabby-genteel character, and in the schools intended for the middle classes it will be elbowed out as far as possible in favour of "gerund-grinding."

ADRIAN.

THE DIFFERENCE OF STATURE AND STRENGTH IN THE TWO SEXES.

A certain Dr. Bebel has been recently contending in a special work that "once upon a time" the average woman was equal in bulk and strength to the average man. Being, however, naturally dependent on their husbands during the seasons of gestation and lactation, they gradually decreased in bulk, and in power alike of mind and body became less able to provide for themselves, and were ultimately reduced to a state of "subjection," as it is called in the "gospel according to John Stuart Mill." This view seems to me utterly out of harmony with the teachings of organic Evolution. In all mammalian groups we find the males surpassing the females in size and weight, the distinction being very marked in the anthropoid apes. If, then, mankind were evolved out of any pre-existing mammalian form, there is a very strong probability, if not certainty, that from their earliest development men were superior to women in stature and strength.

GRADUATE.

NOTES.

"TIME, space, substance, motion, shapes: these five embrace and include the whole of existence or being. They cannot be defined in terms of each other; time and space are not substantial entities. Time is simply time, and space is simply space. Time and space could never have begun to be, can never cease to be, but must just be always. Motion and shapes, though entirely dependent upon substance, are, nevertheless, not substance: light, heat, electricity, sound, &c., are actually not substance, but motion: stars, clouds, hills, stones, atoms, &c., are actually not substance, but shapes. Motion and shapes can begin to be, and can cease to be, therefore they constitute the creation. Motion is not force; force is that which produces motion; force is in substance; force is, in fact, substance. And it is actually inconceivable how aught else can produce motion except will; hence force must be called 'Will-force.' Substance, therefore, which is actually spirit, must have will-force, or it could not move itself into shapes. Those are the conclusions at which modern philosophic science is already arrived, and whoever has not heard them is not abreast of the age."

By the lamented death of Dr. W. B. Carpenter, F.R.S., the Royal Microscopical Society has lost one of its most valued Fellows: his work as a physiologist, and in connection with the University of London, has been already noticed in the various daily and other journals. His experience in the use of the microscope dates from a short time after the introduction of the achromatic instrument into this country; he is best known as an histologist by his researches on the Structure of the Shells of Mollusca, undertaken almost at the outset of his microscopical career, but considerably modified by his subsequent observations. The structure of Foraminifera was a subject he had made especially his own, and enabled him to pronounce a decided opinion as to the nature of a, at the time, much disputed fossil, *Eozoon Canadense*, specimens of which, prepared by himself, may be seen in the collection of the Royal Microscopical Society, and an inspection of which will do more to assist the microgeologist than reading the whole series of controversial papers issued some years ago on the difficult subject of its real nature. He not merely examined the results of deep-sea dredgings, but accompanied more than one deep-sea expedition, and, although not one of the "Challenger" scientific voyagers, he did much towards working up that portion of the collection with which he was best acquainted. He was President of the Royal Micro-

scopical Society in 1854 and 1855, and filled the chair of the younger society, "The Quekett Club," last year. Like all true men of science, he was always ready to communicate to others his vast store of knowledge; his kind assistance, so freely rendered, will be long remembered by those who enjoyed the privilege of meeting him.

During their financial year, ending Midsummer, 1885, the Council of the Royal College of Surgeons admit having paid upwards of £10,000 to examiners! Can we wonder that examinationism flourishes when it is so liberally endowed?

It appears that emissions of poisonous waters—possibly solutions of hydrogen sulphide—occur in the lagoons of atolls, destroying all fish, mollusca, and corals. Such an outbreak occurred at the Keeling Islands, in January, 1876, immediately after a cyclone of exceptional violence.

Of posthumous honours awarded to scientific men long after their death, the most striking instance is the erection of a monument to Archimedes, by the inhabitants of Syracuse.

According to M. Bonnal the temperature of an infant at the moment of birth is generally higher than that of the mother.

We regret to learn, from the "American Naturalist," that a party of English sportsmen wantonly killed from twenty to thirty of the bison-herd preserved in the Yellowstone National Park. A member of Congress has been fined for damaging the geyser-deposits.

At the Grenoble meeting of the French Association M. Mortillet read a paper in which he sought to prove that in the Tertiary epoch there existed an ancestral form of historic man, —an animal less intelligent than existing man, but more intelligent than the existing apes. He names this animal *Anthropithecus*.

Even Mexico feels the necessity of State aid to Science, and has established a *Comision Cientifica* for research into every department of human knowledge.

According to Lieut.-Col. Moody, 42 per cent of recruits applying for enlistment in the Army are rejected on the ground of bodily unfitness..

The Dufferin Terrace at Quebec is lighted electrically, the power being obtained from the Falls of Montmorency, at the distance of nearly 9 miles.

An epidemic among hares is raging in the central parts of France. The flesh of these animals, if eaten, occasions serious indisposition, though it presents no unusual appearance.

We regret to learn that the celebrated Godefroy Museum at Hamburg is in course of being broken up. A part of it has been purchased for the Museum of Leipzig.

The flowers of *Lantana camara*, of a deep golden yellow, change before fading to orange and scarlet; *L. nivea* opens white, and changes to blue; *L. mixta* also opens white, and changes through yellow and orange to red.

The predominance of the polar current during the year now drawing to a close has been exceptional, both in its dry and its rainy portions.

According to investigations made by the medical inspectors of the Local Government Board, schools, under the present system, rank among the chief agencies for spreading diphtheria.

The death of Dr. W. B. Carpenter deserves to be put on record. He was an opponent of Evolution and of Spiritualism, which he sought to account for by the grossly inadequate hypothesis of "dominant ideas."

According to the researches of Prof. O. Marsh, of Newhaven, brain-growth was an important element in the survival of animal species.

NOTICE.

With this number the "Journal of Science," at least under present auspices, will cease to appear. The Editor accordingly bids a kindly farewell to all his contributors, correspondents, and readers. He fully appreciates the sympathy and encouragement which he has received from thinkers of the most widely differing opinions. Most of all he is gratified by the abusive letters, chiefly anonymous, which have been addressed to him by Bestiarians. To have earned their vehement disapprobation is proof that his labours as "servus servorum Scientiæ" have not been in vain.

INDEX.

ACCLIMATISATION, by J. W. Slater, 205
— from Another Side, 738
Animals, New Researches on Fecundation of, by Prof. Van Beneden, 20
— and Vegetables, Distinctions between, 275
Audibility, Telephonic, by Count Reichenbach, 264
Archæopteryx, on the, 470
Axolotl and its Susceptibility to Transformation, 342

BEAUTIFUL, the, Origin of Idea of, by D. Y. Cliff, 193
Bell-Buoys and Bell-Signalling, by Rev. S. Barber, 141
Bolivian Monster: Testimony in Science, 195
British Association and Sir Lyon Playfair's Presidential Address, 611

CELL, Unnucleated, Lessons of, by the Author of "Scientific Materialism," 249
Chemical Elements, Evolution applied to, by Count Reichenbach, 377
— Forces, Theory of Action of, 643
— Science, Recent Development of, 13
Civilisation, Parasites of, 390
Colour-Blindness in Mercantile Marine, Testing for, by Jabez Hogg, F.R.M.S., M.R.C.S., 409
Comet-Systems, by J. R. Sutton, 185
Conception of Ideas, by D. Y. Cliff, 332
Cosmogony, New, 213

DARWIN'S Masterpiece, Characterisation of, by O. Dawson, 441
Death, Universal? 68
— and Individuality, by C. S. Minot, 72
Debateable Land, From the, 726
Double Monstrosities, Origin and Production of, 290

EARTH, Form of, by Major-Gen. A. W. Drayson, F.R.A.S., 319
Epping Forest, Glance at, 536

FIBROUS Products in India, Treatment and Cultivation of by G. O'Brien, 62
Fishes, Lateral Line of, 44
Flowers and Fruits, Colouring-matters of, 201
— and Insects, 543

GENERATION, Strassburger's Theory of, 673
Georgia, South, by Count O. Reichenbach, 327

HOMER Colour-Blind, by Jabez Hogg, F.R.M.S., M.R.C.S., 313
Horses, Hereditary Transmission of Stature to Female Descendants in, 407
How, When, and Where Sewage is Injurious, by J. W. Slater, 267
Human Tail, the, 416

"IGNORAMUS et Ignorabimus," 465
Indian Steel, by L. D'A J., 710

LIGHT, Chemical Action of, 479
— Sanitary Agency of, 594
— Solar and Earth's Atmosphere, by Count O. Reichenbach, 649
Luminosity of Marine Animals, the Cause and the Purpose of the, 740
Lunar Observations, Errors in, by Major-General A. W. Drayson, F.R.A.S., 579

MADMEN and Madness at Rome, 587
Malaria, Recent Researches on, 661
"Mignonette" Case, Lessons of, 57
Mummy-Wheat, Supposed Germination of, by H. King-Parks, 604

NEEDLE Ordeal in Witchcraft, 539
Noises and their Recognition, 336
Nutriment, Cellular and Extra-cellular, Transportation of, 328

PERIODICITY in the Organic World, 282
Physiology and its Opponents, 598, 651, 719
Planets beyond Neptune, Misapprehensions of Leverrier and Adams as evidence for, by Count Reichenbach, 1
Plants, Relation between Structure and Station of, 219
Poison-Secreters, by J. W. Slater, 666
Population Question, 505
Protozoa, Question of Immortality of, 204
Psychography, 143

SANITARY Agency of Light, 707
— Reform, Limits of, 149
— Vagaries, 84
Seas, Ancient, Problematical Organisms of, 410
Seen and Unseen, Interbond of the, by the Author of "Scientific Materialism," 569, 633, 697
Senses, Inter-relation of, 285
Sewage, Composition of, by J. W. Slater, 385
— Precipitation Vindicated, 473
Silk and its Secretors, 345
Space and its Dimensions, 78
Spectral Rays, Spontaneously Reversible, 349, 398
Spiritualism and Science, Relations between, by R. M. N., 400
— —, by the Author of "Scientific Materialism," 458, 511
Sugar-Industry, by R. Galloway, M.R.I.A., 155
Sun, Heat of, by E. H. Cook, B.Sc., F.C.S., 121
Stars, Variable, by J. R. Sutton, 33

THINGS *versus* Words. by F. Fernseed, 516
Tides, New Theory of, by R. Bell, 139
Torpedo, Irreciprocal Conduction in the Electric Organ of the, 732
"Trading-Rat," the, 656

WALL-PAPERS, Arsenical, Poisoning by, by Jabez Hogg, F.R.M.S., M.R.C.S., 522
Waters and Soils, Self-purification of, 533

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